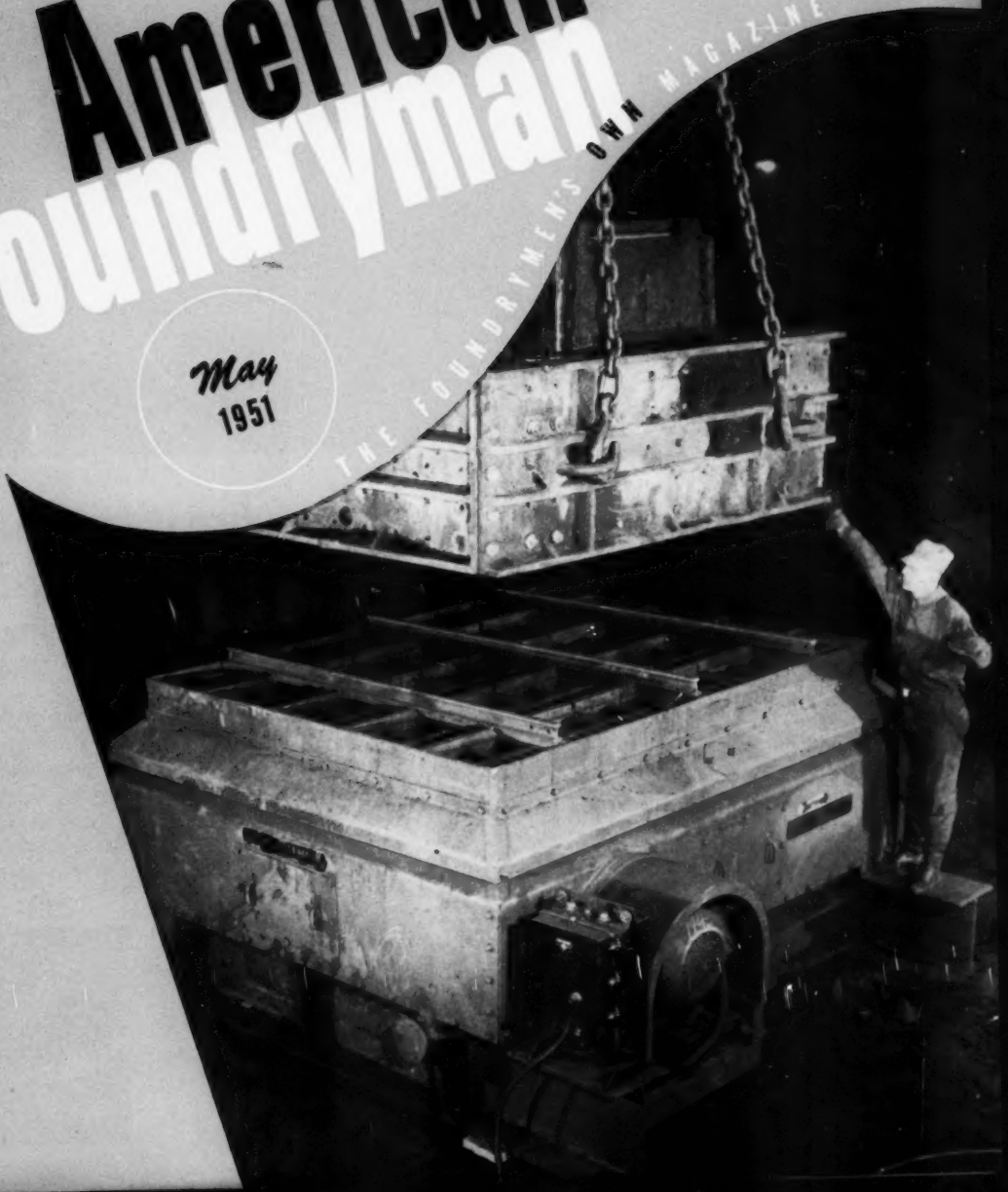
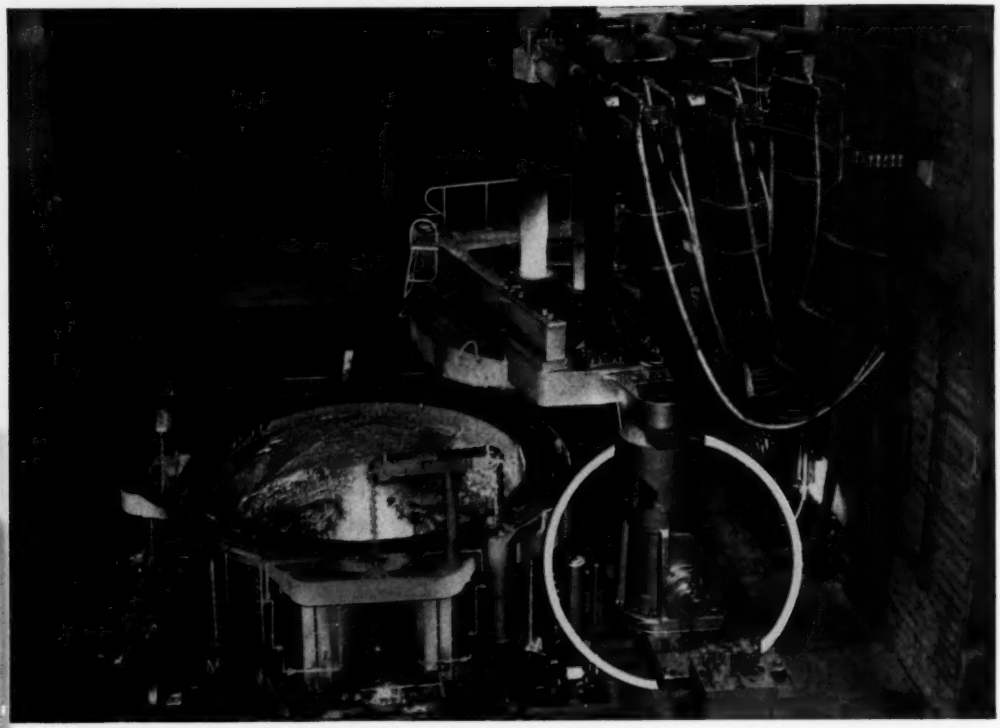
American Foundryman

THE FOUNDRYMEN'S OWN MAGAZINE

May
1951





Its swinging roof has its feet firmly planted on the ground

You swing a lot of weight—and fast—when you open a Lectromelt Furnace for charging. But that weight is carried on a foundation completely independent of the furnace itself, so the support is rigid and there's no strain on the shell.

Because every ounce of the sturdy top structure of a Moore Rapid Lectromelt Furnace rides on massive oil bearings, it swings aside easily and smoothly. No chatter to shake roof bricks loose.

This combination helps make Lectromelt electric arc furnaces the best choice for melting, refining, smelting and reduction. For more details on these furnaces, write for Catalog No. 8. Pittsburgh Lectromelt Furnace Corporation, 316 32nd Street, Pittsburgh 30, Pennsylvania.

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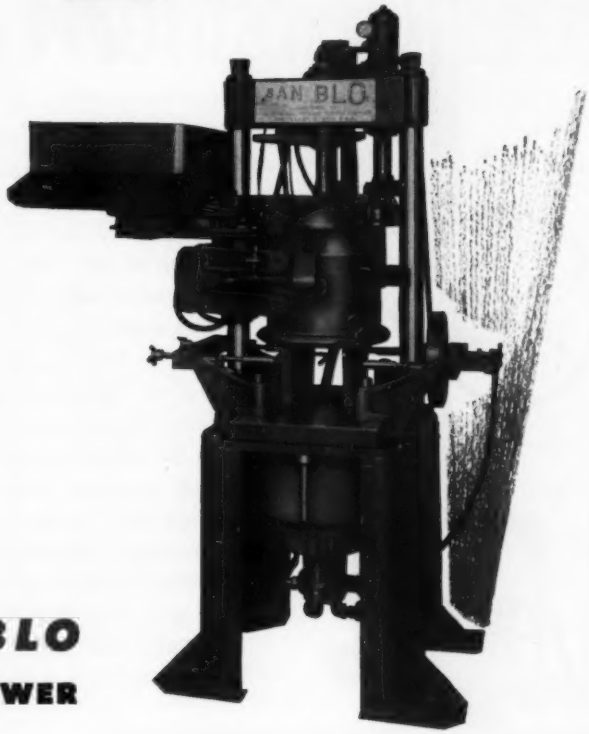
WHEN YOU MELT...

MOORE RAPID

Lectromelt

. . . blows <u>all</u> core mixtures!



SAN-BLO
CORE BLOWER

Iron, steel and non-ferrous foundries are boosting production and slashing core room costs with the new, all-purpose SAN-BLO. They're blowing cores and sand mixtures always rammed before . . . blowing sand with higher green strength and moisture content than ever before possible . . . eliminating core rods and driers in many cases. Foundries, large and small, are finding new economies in SAN-BLO. Why not investigate? Send for bulletin CB-2, today.

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The FEDERAL FOUNDRY SUPPLY Co.

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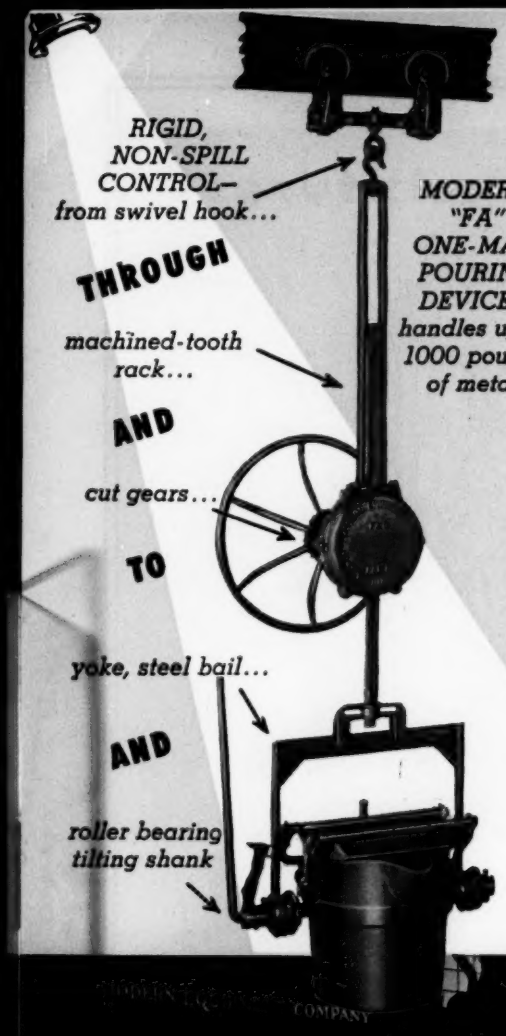

WHILE some of our nation's most highly mechanized foundries are producing, 'round the clock, and close to peak capacity—others aren't. Fortunately for everybody many foundries can POUR MORE! Wherever there is any appreciable volume of hand pouring, MODERN can help along with rigid, geared POURING DEVICES. MODERN Pouring Devices and ladles team together to give that all important rigidity from monorail to ladle bail. Tonnage goes up! Scrap comes down! Here in the Sivyer steel foundries in Milwaukee the "FA" Pouring Devices have served faithfully for more than seven years with little attention. The stainless and nickel steels come on at 3200°F. Eight, 37 pound, industrial valve bodies are poured at split second speeds from MODERN 300 pound ladles. MODERN rigidity from monorail track to ladle spout is a timely story...

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MAY, 1951

VOLUME XIX, NUMBER 5

American Foundryman

May, 1951

Official publication of American Foundrymen's Society

Editorial: Is This Where We Came In?: George K. Dreher.

55th A.F.S. Convention News Story.

Exceed A.F.S. Building Fund Goal.

Elect 1951-52 A.F.S. Officers and Directors.

Watch Your Cast Iron Chills!: F. E. Sutherland.

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Zircon Sands—Properties and Uses in Cores and Facings: Arthur Smith.

Modern Foundry Methods—

Set Up Casting Welding Standards and Procedures: John D. Wozny.

Determine Silicon-Copper-Iron in Monel Metal: Walter L. Miller and George Norwitz.

The Round Table: Discuss Preventing Casting Defects.

Industrial Engineer in the Foundry: Douglas C. Williams.

Who's Who.

New A.F.S. Members.

Foundry Personalities.

Chapter Activities News.

Future Chapter Meetings.

Letters to the Editor.

Abstracts of Technical Articles.

New Foundry Products.

Foundry Literature.

Foundry Firm Facts.

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Less than two minutes are required to shake out this 13½-ton load of flask, casting, and sand on the 8 x 10 ft shakeout in the Allis-Chalmers Mfg. Co. foundry at West Allis, Wis. The unit has a continuous capacity of 25 tons and is capable of handling the entire flask shakeout and core knockout requirements of a large jobbing foundry.

Published monthly by the American Foundrymen's Society, Inc., 616 S. Michigan Ave., Chicago 5. Subscription price in the U. S., Canada and Mexico, $3.00 per year; elsewhere, $6.00. Single copies, 50c. Entered as second class matter July 22, 1938, under Act of March 3, 1879, at the Post Office, Chicago, Illinois. EASTERN REPRESENTATIVE—C. A. Larson & Associates, 254 West 31st St., New York 1, N. Y. CENTRAL REPRESENTATIVE—Enright & Cleary, 1836 Euclid Ave., Cleveland. MIDWESTERN REPRESENTATIVE—H. Thorpe Covington Co., 677 N. Michigan Ave., Chicago.

Fast, Safe TRAMRAIL at

A heavy centrifugal dryer casting being inspected by General Superintendent H. T. Hendricks and Heavy Floor Foreman L. L. Boone. This piece weighs 3820 lbs. Castings weighing from two oz. to 5300 lbs. are produced at McNally Pittsburg.

McNally Pittsburg Foundries, Inc.

FOUNDERS OF PROCESS & ALLOY CAST IRON

Pittsburg, Kansas

Engineering Division
THE CLEVELAND CRANE & ENGINEERING CO.
Wickliffe
Ohio

Gentlemen:

We have your query about our present Cleveland Tramrail system. As you know, Tramrail was selected to service our three machine molding floors and the core department when this Foundry was built in 1945. Electric hoists are used.

The requirements were unusual. The machine floors handle a wide variety of work, calling for two to three types of metal during the day. Furthermore, the metal is scheduled on a semi-continuous basis, split into two separate heats. In addition, heavy flasks must be delivered to pouring conveyors and poured flasks must be delivered to the shakeout while the pouring cycle is proceeding.

This requires maximum flexibility in serving the floors with flasks, cores and metal; which was the determining factor in selecting Tramrail.

In our opinion, the experience over the past years has amply proven the success of your original recommendations. We feel that Tramrail is the most efficient and economical system for handling such a diversity of service demands.

Cordially,

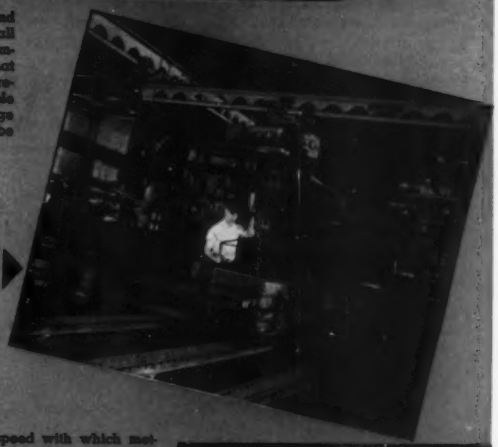
H. T. Hendricks
Superintendent

HTHendricks
trc

Service PROVIDED BY CLEVELAND McNALLY PITTSBURG FOUNDRIES

The core room foreman and one core man can handle all cores with a Cleveland Tramrail bridge and hoist that travels the length of the core-making floor. Considerable time would be lost if the large volume of cores had to be hand-lifted.

Flasks are easily closed by use of the Tramrail equipment and moved to correct pouring conveyor with minimum lost motion.



The speed with which metal can be handled demonstrates the efficiency of Cleveland Tramrail equipment and the time that can be saved through its use. Ladles leave the cupola in order poured and go directly to pouring stations on three floors without waiting for other ladles.

Pouring the medium floor with an average of 11,000 lbs. per day, the Cleveland Tramrail equipment has proven fast, flexible and safe. This bridge is reserved for this ladle. An average of 132 molds are poured per day.

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BOOKLET No. 2008. Packed with valuable information. Profusely illustrated. Write for free copy

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
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CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

53 BLAST FURNACES LINED WITH NATIONAL CARBON,

TRADE-MARK

HAVE AVERAGED 1,000,000 TONS EACH

– *and still going strong!*

● National Carbon Company has now equipped 53 furnaces with carbon-block linings. 27 of these linings have produced over 1,000,000 tons of iron apiece at this writing. 10 of these linings have produced 1,500,000 tons. One lining has topped 1,900,000 tons. All linings are still going strong. We can think of no stronger proof of the value of "National" carbon for lining blast furnaces.

The term "National" is a registered trade-mark of
NATIONAL CARBON COMPANY
a Division of
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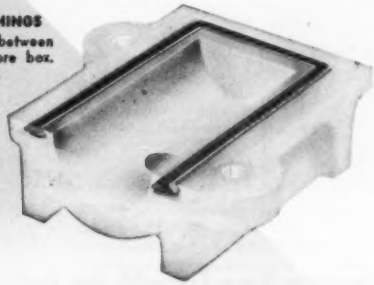
"PROTEXABOX PINS"
Cannot mar the box face because they will not loosen. Protective rubber tip guaranteed to stay on.

"SAND ARRESTER TUBE"
Save cores and step up production. Guaranteed for 100,000 blows.

Every Martin product is designed especially for "core box protection"—each is built to prevent a specific type of wear on your core boxes. They are engineered by foundry men to assure easy installation, successful operation. Martin products add years to the life of your equipment by enabling you to salvage old plates and core boxes, by preventing abrasion, and giving your plywood blow plates the lasting qualities of steel. Each product carries a guarantee of absolute satisfaction. Martin products are distributed all over the world by foundry supply houses.

"PULLINSERT" BLOW BUTTONS
Positively stop sand blasting under blow holes. Available in nine popular sizes.

"HOLINER" BUSHINGS
Stop abrasion between blow plate and core box. Protect blow holes.



"STRIPINSERT"
Protects parting line—easily installed in old or new boxes. Cutters for groove available at moderate cost.

"VIBROLATOR"

The powerful all-directional vibration of the Peterson Vibrolator makes this an ideal unit for keeping materials flowing in chutes or hoppers. The Vibrolator will not crack attaching lugs on match plates or core boxes. Instantly self starting and virtually noiseless in operation, this new type vibrator eliminates maintenance worries and gives a long, dependable service life. No lubrication is necessary. The Vibrolator is light in weight to lessen fatigue and permit maximum delivery of vibration. There are five sizes available to meet all your foundry requirements. Peterson Vibrolators are sold only by Martin, exclusive manufacturers of ball-type vibrators.

"VIBROLATOR"

WRITE for folders describing these Martin products in detail. If you have a sand movement problem, send us complete information and our engineers will prescribe the correct vibrator for your needs.

MARTIN ENGINEERING COMPANY
KEWANEE, ILLINOIS

Moline Malleable now makes larger and more complex cores with THERMEX *Core-baking Equipment than were possible with their former equipment. This progressive company reports that* THERMEX *Core-baking Equipment "brings about the most important improvement in core-baking operations in years."*

Thermex
ELECTRONIC CORE-BAKING EQUIPMENT

"pays for itself in less than a year"

—MOLINE MALLEABLE IRON CO.

A partial list of companies who have purchased THERMEX Electronic Core-baking Equipment

American Hardware Corp.
Brugger Manufacturing Co.
Crane Company
Ford Motor Co.
Grand Haven Brass Foundry
Grinnell Company, Inc.
Moline Malleable Iron Co.
National Malleable & Steel Castings Co.
Ontario Malleable Iron Co.
Phoenix Brass Fittings Corp.
Ronci Company
Sterling Faucet Company
United Foundries, Inc.
United States Pipe & Foundry Co.

"WE ESTIMATE," states Moline Malleable Iron Co. of St. Charles, Ill., "that our new THERMEX Core-baking Equipment will pay for itself in less than a year. We have just placed an order for a second THERMEX installation." Here's why:

- **Labor costs have been cut drastically, in the baking department, and in the core-making department as well.**
- **Utility costs per ton of sand have been cut more than 50%.**
- **Only one-fourth the floor space of conventional baking equipment is needed —freeing this space for other work.**
- **Core rejects have been reduced 66%.**

Why not take advantage of the labor-saving, cost-cutting advantages of THERMEX Core-baking Equipment? Girdler manufactures dielectric core-baking equipment in capacities from ½ ton to 15 tons per hour. For complete data write The Girdler Corporation, Thermex Division, Louisville, Kentucky.

THERMEX—T. M. Reg. U. S. Pat. Off.

THE GIRDLER CORPORATION
Thermex Division

PANGBORN ROTOBLAST* CABINET CLEANS UP TO 200 ENGINE BLOCKS AN HOUR

at world's largest independent jobbing foundry

ABOVE: This rear view of Campbell, Wyant, Cannon's Pangborn "ES" ROTOBLAST Cabinet shows the conveyor system and four ROTOBLAST Machines. Inside the cabinet, the conveyor stops in front of each ROTOBLAST unit and slowly revolves the casting in the blast stream to assure complete cleaning.

Loading the heavy cylinder blocks on the conveyor is easily handled by two men.

BLAST CLEANING at Campbell, Wyant, Cannon Foundry Co., of Muskegon, Mich., is fast, efficient and *mechanized!* And the secret of this performance is two Pangborn "ES" ROTOBLAST Cabinets like that shown above. Heavy engine blocks can be cleaned at a rate of *200 an hour* . . . and cleaning is automatic! The result is faster, better, cheaper blast cleaning than ever experienced with other equipment.

Campbell, Wyant, Cannon started to mechanize their cleaning operation in 1937 . . . when they installed one of the first Pangborn monorail ROTOBLAST Cabinets. Later they installed a second Cabinet to meet production demands. As a result cleaning costs have been even further reduced, and there's no cleaning room bottleneck. Cleaning is a simple, automatic operation with high-quality work assured.

ROTOBLAST . . .

SAVES LABOR with push-button operation
SAVES SPACE because machines are compact
SAVES TIME by cleaning more loads per day
SAVES POWER since no compressor is needed
SAVES TOOLS because all scale is removed

GET THE COMPLETE ROTOBLAST STORY: Bulletin 214 is informative and covers many applications. Write for your free copy to: Pangborn Corporation, 1300 Pangborn Blvd., Hagerstown, Md.

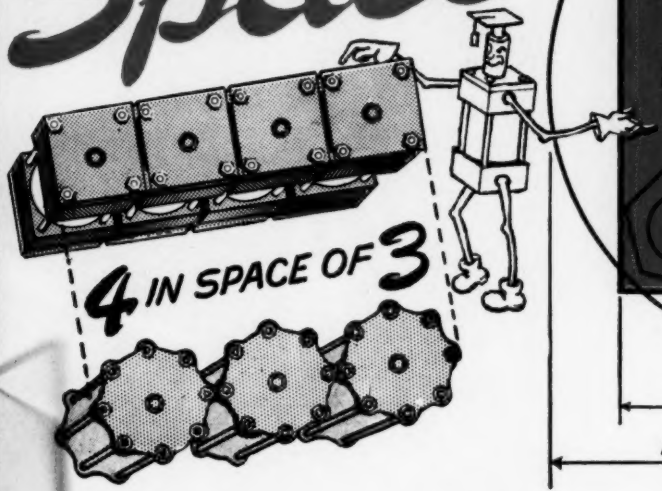
Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment.

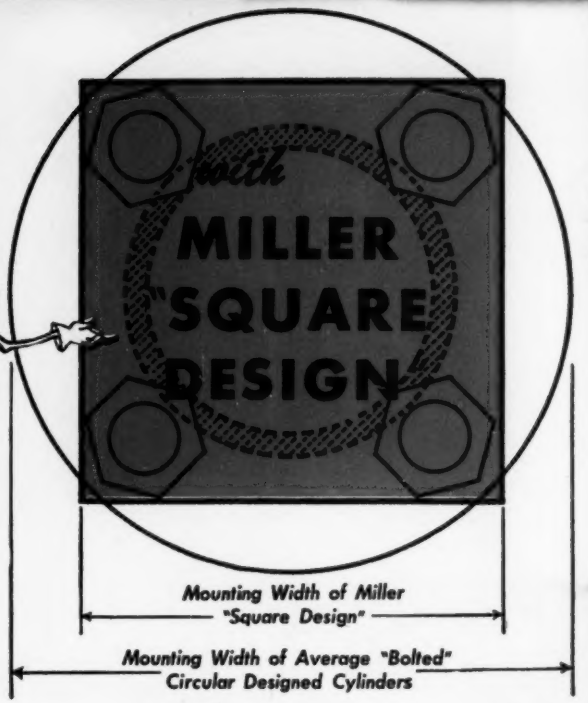
Pangborn

BLAST CLEANS CHEAPER

with the right equipment for every job

Save Space





Air *and* Hydraulic CYLINDERS...

Benefits to You!

- More Cylinder Power in Same space
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- Simplify Designing and Installation
- Save hours of Drafting Time

The SQUARE DESIGN of Miller Cylinders saves up to 25% of mounting space, permitting more cylinder power in the same space and easier, more convenient installation in "tight spots." Thus, in many cases, machines and equipment can be designed more compact and less costly by using Miller Cylinders. Hours of drafting time can be saved — as only a few straight lines show any view on drawings.

The illustration at upper left shows graphically how *four* Miller Cylinders can be mounted, bore for bore, in the same space required for *three* average "bolted" circular designed cylinders. Some Miller bore sizes permit even greater space-savings.

Other important *standard* features of all Miller Cylinders include: solid steel heads, caps and mountings, hard chrome plated piston rods, dirt wiper seals, and other "quality" features as shown in illustrated bulletins sent FREE on request. Remember, too, that Miller Hydraulic Cylinders (2000-3000 psi) meet the J. I. C. Hydraulic Standards.

Write for illustrated cylinder bulletins A-105 and H-104

COMPLETE MILLER CYLINDER LINE INCLUDES: AIR CYLINDERS, 1½" to 20" BORES, 200 PSI OPERATION; LOW PRESSURE HYDRAULIC CYLINDERS, 1½" TO 6" BORES FOR 500 PSI OPERATION, 8" TO 14" BORES FOR 250 PSI; HIGH PRESSURE HYDRAULIC CYLINDERS, 1½" TO 12" BORES 2000-3000 PSI OPERATION. ALL MOUNTING STYLES AVAILABLE.

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LOST TIME • LOST LABOR • LOST PROFIT

Cleanse your molten iron with

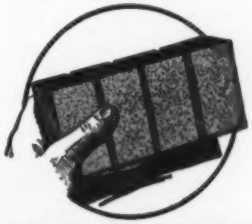
Famous CORNELL CUPOLA FLUX

and your scrap loss will be amazingly low.

Leading foundries producing gray iron castings, and malleable foundries with cupola operation, make it a "must" that Famous Cornell Cupola Flux be used with every charge, to ensure clean, hotter, more fluid iron, reduce sulphur—and obtain castings with the minimum of chilled sides, hollow centers and hard spots, and greatly facilitate machining operations.

CUPOLA OPERATION IS MORE EFFICIENT. Drops are cleaner. There is less erosion of brick or stone lining. Maintenance cost is practically nil.

WRITE FOR BULLETIN NO. 46-B



PRE-MEASURED SCORED BRICK FORM makes it the easiest and most economical flux to use. No waste.

Simply lift Famous Cornell Cupola Flux from container and toss it into cupola with each ton charge of iron, or break off one to three briquettes (quarter sections) for smaller charges, as per instructions.

Famous CORNELL BRASS FLUX

CLEANSES MOLTEN BRASS even when dirtiest brass turnings or sweepings are used. You pour clean, strong castings which withstand high pressure tests and take a beautiful finish. The use of this flux saves you considerable tin and other metals, and keeps crucible and furnace linings cleaner, adds to lining life and reduces maintenance.

The CLEVELAND FLUX Co.

1026-1060 MAIN AVENUE, N. W., CLEVELAND 13, OHIO

Manufacturers of Iron, Semi-Steel, Malleable, Brass, Bronze, Aluminum and Ladle Fluxes—Since 1918

FAMOUS FLUXES
Trade Mark Registered

Famous CORNELL ALUMINUM FLUX

CLEANSES MOLTEN ALUMINUM so that you pour clean, tough castings. No spongy or porous spots even when more scrap is used. Thinner yet stronger sections can be poured. Castings take a higher polish. Exclusive Formula greatly reduces obnoxious gases, improves working conditions. Dross contains no metal after this flux is used.

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ELECTROMET Data Sheet

A Digest of the Production, Properties, and Uses of Steels and Other Metals

Published by Electro Metallurgical Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. • In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

How CHROMIUM BRIQUETS Increase Hardness and Strength of Cast Iron

Chromium briquets are made especially for the addition of chromium to cast iron in the cupola. The amount added may vary from small percentages up to as high as 15 per cent.

Function of Chromium in Cast Iron

Chromium is added to cast iron for the purpose of refining the grain and stabilizing the combined carbon content, thus increasing strength, hardness, and resistance to wear and abrasion. Even very small additions of chromium have a decided effect, and as little as 0.25 to 0.50 per cent will yield a great improvement in iron used for resistance to wear. A typical application is in automotive cylinder castings, particularly in heavy-duty truck and tractor work.

The stabilizing and refining effect of chromium is particularly useful to foundrymen producing castings of medium to heavy section. The slow cooling of such castings often results in weak, open-grained iron. Chromium in amounts up to 1.00 per cent will increase the stability of the structure of the castings and help to offset the effect of slow cooling in the mold.

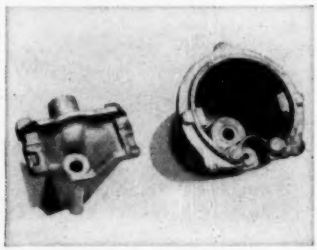

Fig. 1—These low-chromium iron castings, which are parts for a die-casting machine, are machinable, uniformly hard, and resistant to the effect of high temperature.

High-Temperature Service

The strong effect of chromium in stabilizing the structure of gray iron has made its use in iron subjected to high temperatures almost universal. Chromium in the range of 0.75 to 1.25 per cent greatly reduces the growth and warping that occur in unalloyed irons as the result of repeated heating and cooling. Chromium cast irons in this range of chromium content may be inoculated with silicon alloys to decrease the tendency to chill and, also, to assist in maintaining machinability. Such irons are adaptable to various high-temperature applications, such as melting pots, die-casting machine parts, grate bars, etc.

How Binder Protects Chromium

For the addition of chromium to cast iron, ELECTROMET produces briquets containing exactly 2 lb. of chromium each. The alloy is protected by a refractory binder, which has a high melting point and, therefore, helps to prevent oxidation of the chromium until it is melted and delivered to the crucible of the cupola.

The recovery of chromium from "EM" briquets is thus uniformly high, normally above 85 per cent, and it is easy to obtain the desired final chromium content. This is of particular importance when the limitations of hardness and machinability for a casting demand close chemical control.

Typical Briquet-Iron Mixture

The use of "EM" chromium briquets in the production of cast iron of low chromium content is shown in the table below.

Fig. 2—"EM" chromium briquets are hexagonal in shape, and each contains exactly 2 lb. of chromium. Notched briquets (right), which are easy to break in half, can be purchased for use when 1 lb. additions of chromium are desired.

The mixture given is for a medium-strength iron used for castings in which resistance to wear or heat is required.

Booklet Available

Typical briquet mixtures for other types of irons are given in the booklet "Briquetted Alloys for the Iron Foundry Industry." This booklet also contains information about "EM" briquets of silicon, silicomanganese, and ferromanganese. If you would like a copy, free of charge, simply write to the address given above or to the ELECTROMET office nearest to you. Offices are in Birmingham, Chicago, Cleveland, Detroit, Los Angeles, New York and San Francisco. In Canada: Welland, Ontario.

The terms "EM" and "Electromet" are registered trade-marks of Union Carbide and Carbon Corporation.

Typical Briquet Mixture for Low-Chromium Iron

Base Charge			Alloys in Charge Material					
			Silicon		Manganese		Chromium	
Per Cent	Lb.	Material Charged	Per Cent	Lb.	Per Cent	Lb.	Per Cent	Lb.
20.0	200	Pig Iron	2.25	4.50	0.85	1.70	—	—
30.0	300	Return Scrap	2.00	6.00	0.75	2.25	0.57	1.71
30.0	300	Purchased Scrap	2.00	6.00	0.65	1.95	—	—
20.0	200	Steel Scrap	0.10	0.20	0.45	0.90	—	—
100.0%	1,000 lb.	Total Base Charge		16.70 lb.		6.80 lb.		1.71 lb.
Briquets Required		5 Silicon Briquets		5.00		—		—
		1 Silicomanganese		0.50		2.00		—
		2½ Chromium Briquets		—		—		5.00
		Total Alloys Charged		22.20 lb. Si or 2.22% Si		8.80 lb. Mn or 0.88% Mn		6.71 lb. Cr or 0.67% Cr
		Melting Recovery		x .90		x .85		x .85
		Final Iron Analysis		2.00% Si		0.75% Mn		0.57% Cr

is high man...

Illustration: Mr. George Garvey of City Pattern and Foundry, South Bend, Indiana observing the checking of an "ACCURATE" cope and drag set for an M. B. Skinner Co. 12" split coupling used for repairing broken cast iron mains.

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Foundries everywhere are looking for means to increase production and lower their costs. ACCURATE cope and drag sets have helped to solve this problem for hundreds of the leading foundries from coast to coast.

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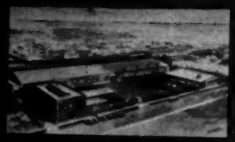

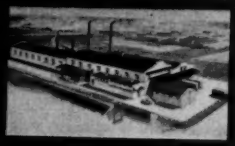

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Foundry CORE Practice

A Revision of "MODERN CORE PRACTICE AND THEORIES"

. . . dealing exclusively with the production and use of cores in the modern foundry

Fig. 117—Bench-type Core Blowing Machine

Fig. 190—High-frequency Dielectric Core Baking Oven

Written in practical, understandable language for operating men and metallurgists, FOUNDRY CORE PRACTICE covers the entire cycle of core-making operations . . . from materials and mining methods to final setting of cores and molds.

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FACTORS AFFECTING CORE BAKING
CORE OVENS AND THEIR CONTROL
CORE FINISHING OPERATIONS
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CORE HANDLING
PROCEDURES FOR DETERMINING THE PROPERTIES OF CORES AND CORE MIXTURES
CONTROLLING CORE PROPERTIES
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CORE KNOCK-OUT
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Tin is in short supply. This means that many of the bronze casting alloys containing substantial percentages of tin are frequently difficult to obtain.

In this situation Federated offers two suggestions that are promising and easy to follow.

When faced with the problem of alloy selection, consult with your supplier. Federated Metals, for example, has the extensive experience . . . in research laboratories and in the field . . . which qualifies its metallurgists to assist you in the selection of the best available alloy and to advise you on problems of foundry practice.

In addition, Federated offers a group of copper-silicon casting alloys with mechanical properties *exceeding those of industrially used tin bronzes.* The group is called HERCULOY* Bronzes.

Herculoy Bronzes combine high strength and excellent physical properties with a high resistance to corrosion. They can replace both ferrous alloys and tin bronzes. Foundrymen like Herculoy Bronzes because of their excellent foundry characteristics. Castings are sharp in detail. The metal pours freely and can be cast into sand or permanent molds. No special equipment or techniques are required for melting and handling Herculoy. No smoke or noxious fumes are produced in melting.

More information on Herculoy Bronzes is contained in a 4-page pamphlet that is yours for the asking. Write for it today . . . or for help with any non-ferrous metal problem.

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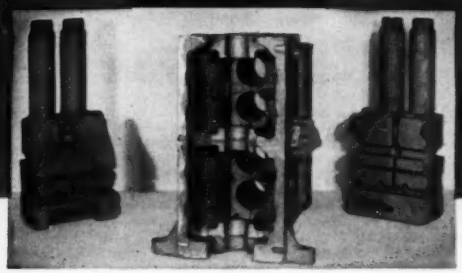
Stevens SEAL-COTE CORE WASH



PREVENTS METAL SEEPAGE
GIVES SMOOTHER CASTINGS
REDUCES SALVAGE

REPORTS WILSON FOUNDRY & MACHINE CO.

Wilson Foundry & Machine Co., Pontiac, Mich., faced a problem in their core room several months ago. The core wash they were using had a tendency to glaze and bubble under high temperatures. Salvage was high due to sand spots—castings came out rough and pitted. So, Wilson Foundry & Machine Co. called in a representative of Frederic B. Stevens, Inc., and told him of their problem. The Stevens man, working closely with the Stevens laboratory and research staff, submitted several samples of core wash. Foundry tests proved that Stevens Seal-Cote Core Wash held the answer to the problem. According to R. E. Kalmbach, Wilson's general manager, since the foundry started using Stevens Seal-Cote Core Wash for automobile engine castings, results have been splendid. "Stevens Seal-Cote is a better filler, gives better coverage, and in general does an all-around better job than other core washes we've used," Mr. Kalmbach states. He adds, "And the Stevens organization gives top-notch service. You can call on the Stevens people at any hour, day or night, and get immediate action on foundry problems."

The Stevens complete line of foundry equipment and supplies stands ready to serve you in your casting operations. Why not call in your nearby Stevens representative today and have him show you how Stevens can help with any foundry problem. Or, if you prefer, write direct to Frederic B. Stevens, Inc., Detroit 16, Michigan, for full information. There's no obligation.

EVERYTHING FOR A FOUNDRY

FREDERIC B. **STEVENS** INCORPORATED

DETROIT 16, MICHIGAN

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Mexican Cordip is just one of the many new products that are continually being developed by the research facilities of The United States Graphite Company. Mexican Cordip is a high temperature coating that gives castings maximum surface smoothness. Dry or green cores maintain true dimensions because Mexican Cordip *will not build up or run on core surfaces.* It penetrates sand to an effective depth to prevent burn-in. Since its development in the laboratories, Mexican Cordip has proven its worth in daily use in some of America's finest foundries. Mexican Cordip is supplied in powdered form complete with binder and is *easy to prepare and use* either as a spray or dip. Also, Mexican Cordip is non-fermenting. There's no messy dip tank cleaning . . . no disagreeable odors.

Small cupola used to simulate actual pouring conditions at The United States Graphite Company laboratory.

1⅛" cores with small cylindrical cavity being charged with metal (left) for insertion into the hot zone of the Dilatometer (right). Metal melts to form a small pellet. After cooling, the core and casting are studied for ease of removal, coating remaining, burn-in, and surface appearance.

MODERN LABORATORY DUPLICATES ACTUAL FOUNDRY CONDITIONS FOR BETTER PRODUCT RESEARCH

Old-time foundry men and newly graduated metallurgists alike who have visited The United States Graphite Company's neat, new foundry research laboratories in Saginaw have been enthusiastic about the completeness of the equipment, *the thoroughness of the tests*—and the extent to which the engineers here are going in order to develop even better Mexican Graphite products for America's foundries.

In this amazingly complete laboratory is a perfect little 4½" diameter cupola that exactly duplicates the results of its big brothers on production. An electric furnace and a Dilatometer are used to study the effect of temperatures up to 3000° F under just about any atmosphere. Metallurgical microscopes are used for closer study (up to 3,000 diameters) of the sand-metal interface of experimental cores and molds.

There is a core oven and complete sand testing equipment so that precise studies can be made of the penetration, effect on surface, and physical characteristic of sand when using various types of Mexican Graphite washes.

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It is largely because of the completeness of this modern laboratory—and the skill, knowledge and creative ability of the engineers here that United States Graphite Company products are so effectively saving production time, cutting costs and helping to assure better castings in America's leading foundries today. *This laboratory is at your service.* Call or write us.

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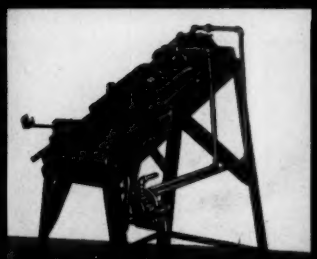

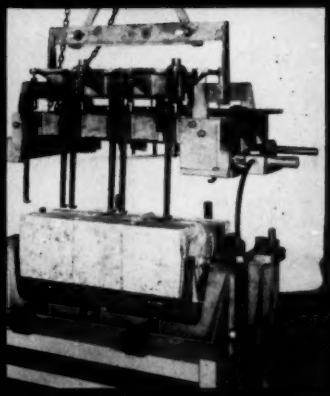

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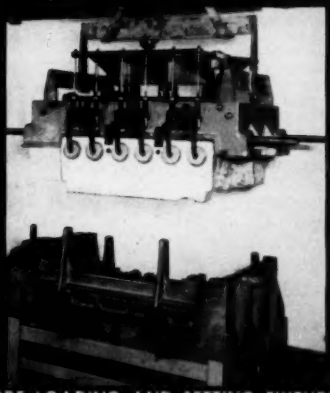

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No longer in the pilot-plant stage, this new material is now produced and sold on the basis of specifications. Not only are its individual properties exceptional, but no other common engineering material provides such a combination of excellent castability and fluidity, with high strength, toughness, wear resistance, and machinability.

Actually, "ductile iron" denotes not a *single* product, but rather a family of ferrous materials characterized by graphite in the form of spheroids . . . a form controlled, in a broad sense, by small amounts of magnesium. Presence of spheroidal rather than flake graphite gives this new product a ductility that is unique among gray cast irons.

Four important types of ductile iron now being produced commercially are tabulated below.

REPRESENTATIVE MECHANICAL PROPERTIES OF COMMERCIAL HEATS OF DUCTILE IRON

	Grade	Tensile strength, psi	Yield strength, psi	Elongation per cent	BHN	Usual condition
A	90-65-02	95/105000	70/75000	2.5/5.5	225/265	As-cast
B	80-60-05	85/95000	65/70000	5.5/10.0	195/225	As-cast
C	60-45-15	65/75000	50/60000	17.0/23.0	140/180	Annealed
D	80-60-00	85/95000	65/75000	1.0/3.0	230/290	As-cast

A Pearlitic in structure. Provides good mechanical wear resistance.

B Pearlitic-ferritic in structure. Provides strength and toughness combined.

C A fully ferritic structure usually obtained by short anneal of either (A) or (B). Provides optimum machinability and maximum toughness.

D Higher phosphorous content than preceding grades, also higher manganese. Provides high strength and stiffness, but only moderate impact strength.

SOME UNIQUE PROPERTIES OF DUCTILE IRON

1. Its elastic modulus, about 25,000,000 psi, is virtually unaffected by composition or thickness . . .

2. It can provide a chilled, carbidic, abrasion-resistant surface supported by a tough ductile core. No other single material can combine these properties . . . its only counterpart being a tough material coated with a hard welded overlay.

3. As-cast ductile iron of 93,000 psi tensile strength has the same machinability rating as gray iron with a strength of 45,000 psi.

4. Annealed ductile iron can be machined at a rate 2 to 3 times that of good quality gray iron.

5. It can be satisfactorily welded.

APPLICATIONS

Automotive, agricultural implement, railroad and allied industries apply ductile iron, as-cast and heat treated, in components too numerous to detail.

Machinery, machine tools, crankshafts, pumps, compressors, valves and heavy industrial equipment such as rolls and rolling mill housings, utilize its high strength and rigidity.

In scores of engine, furnace and other parts serving at elevated temperatures, it provides oxidation and growth resistance heretofore unavailable in high carbon castings.

Other applications include paper, textile and electrical machinery, marine equipment, and pipe.

AVAILABILITY

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Contains all the forms you need to run an impartial test. Remember, Malleabrasive is guaranteed to outperform ordinary shot and grit when comparative tests are properly run. For your free kit, write today to: PANGBORN CORPORATION, 1300 Pangborn Blvd., Hagerstown, Md.

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- *is designed for modern cleaning equipment*
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By adding only 8 ounces or less of DELTA 96•B SAND RELEASE AGENT, per ton, to your core or molding sand mixes, your sands will flow freely . . . be easier to handle . . . easier to use. They will not stick to core boxes or patterns no matter how intricate they may be.

DELTA 96•B SAND RELEASE AGENT is the result of persistent research by DELTA Laboratories devoted to the discovery and development of a lubricant-dispersant for use in sand mixes. DELTA 96•B is a liquid which provides properties hitherto unknown in sand conditioning materials. It is completely volatile at elevated temperatures and does not contaminate the sand.

READ WHAT USERS SAY ABOUT DELTA 96•B SAND RELEASE AGENT

". . . . with the addition of 8 ozs. of Delta 96•B we are now able to blow cores we otherwise couldn't blow."

". . . . Delta 96•B gives the sand improved flowability. Our sand now works much more freely and leaves the core boxes clean."

". . . . and the trouble we had with sand sticking in the hopper, in the chute and on the conveyor has been eliminated with the use of Delta 96•B."

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Prove it yourself in your own foundry. Ask for a test sample. No cost or obligation. You will also receive instructions for use. Write today.

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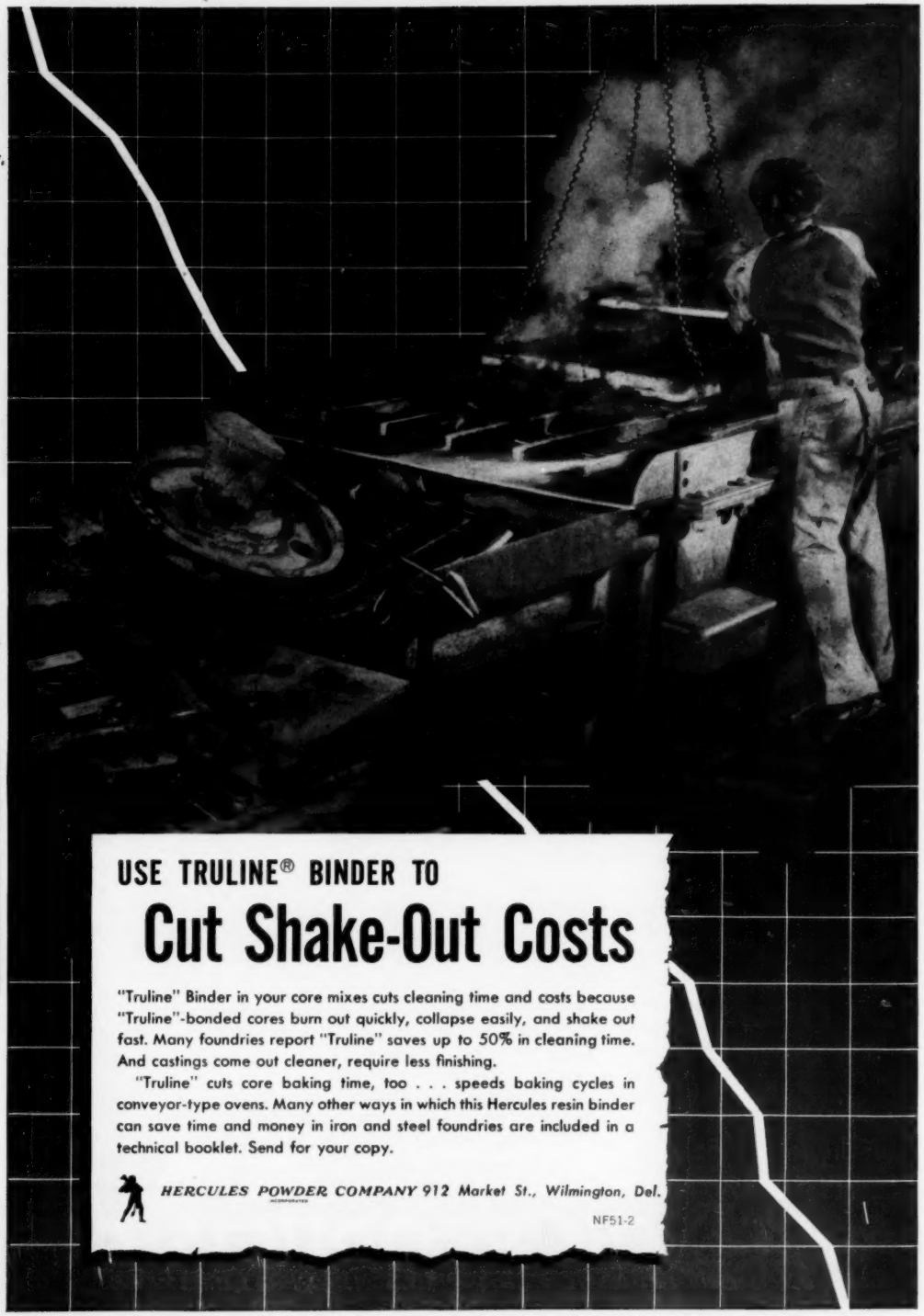

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"Truline" Binder in your core mixes cuts cleaning time and costs because "Truline"-bonded cores burn out quickly, collapse easily, and shake out fast. Many foundries report "Truline" saves up to 50% in cleaning time. And castings come out cleaner, require less finishing.

"Truline" cuts core baking time, too . . . speeds baking cycles in conveyor-type ovens. Many other ways in which this Hercules resin binder can save time and money in iron and steel foundries are included in a technical booklet. Send for your copy.

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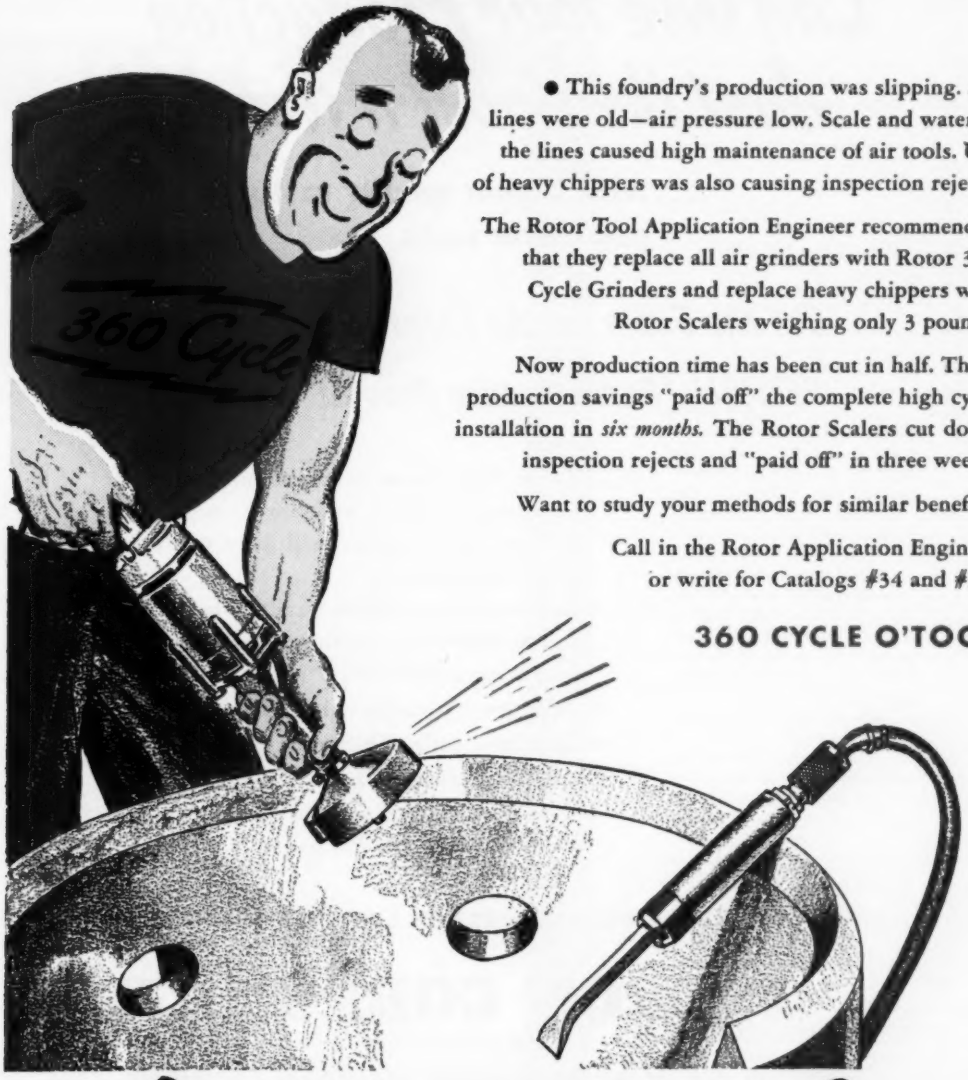

● This foundry's production was slipping. Air lines were old—air pressure low. Scale and water in the lines caused high maintenance of air tools. Use of heavy chippers was also causing inspection rejects.

The Rotor Tool Application Engineer recommended that they replace all air grinders with Rotor 360 Cycle Grinders and replace heavy chippers with Rotor Scalers weighing only 3 pounds.

Now production time has been cut in half. These production savings "paid off" the complete high cycle installation in *six months.* The Rotor Scalers cut down inspection rejects and "paid off" in three weeks.

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Call in the Rotor Application Engineer or write for Catalogs #34 and #37.

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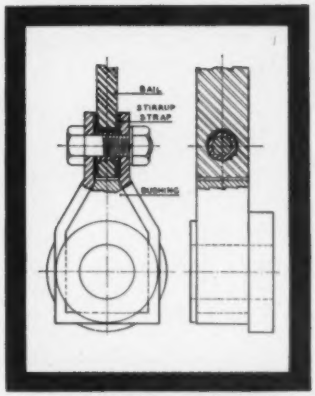

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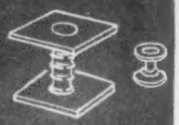
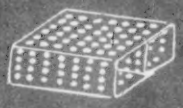
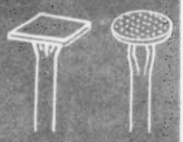
MOTOR 	FUSE READILY STEMS CAN BE GROOVED HEADS CAN BE PERFORATED CLOSE TOLERANCES ± .002 HEADS CAN BE TILTED	*For Light Sections of* Motor Blocks • Heads • Housings Radiator Sections • Burner Sections • Pump Sections • Farm Equipment • Job Castings
BUTTON HEAD OR BOILER	STURDY STRUCTURE FUSE READILY STEMS CAN BE GROOVED NON-SLIP BUTTON HEAD	*For Boiler Sections*
PERFORATED 	10 STANDARD SHAPES MADE TO FIT ALL CONTOURS MADE TO ALL RADII DESIGNED FOR WEDGES LOW IN COST	*For Light Sections of* Stove Castings • Motor Castings Job Castings
DOUBLE HEAD	STURDY STRUCTURE STRONG SUPPORT TO CORE CLOSE TOLERANCES ± .005 STEMS CAN BE GROOVED HEADS CAN BE CANTED	*For Heavy Sections of* Machine Tool Bases • Diesel Engines • Locomotive Frames Side Frames • Pumps • Road Machinery
SINGLE HEAD 	NON-SLIP FORGED HEADS FITTED HEADS WITH ANY RADIUS SOLID SUPPORT	*For Very Heavy Cores of* Diesel Engines • Machine Bases
RADIATOR	UNIFORM BREAK-OFF NICKS DEEP NICKS FOR FIRM KNITTING LOW COST	*For Radiator Sections*
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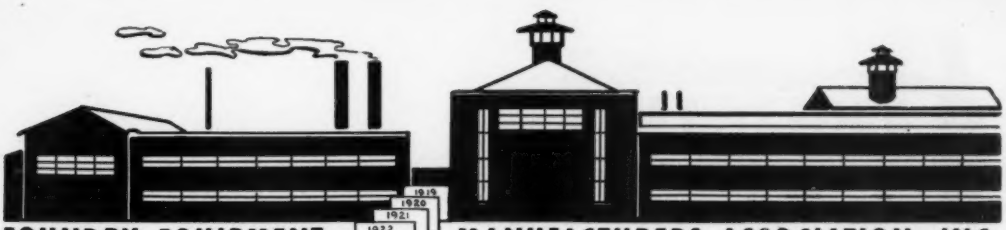

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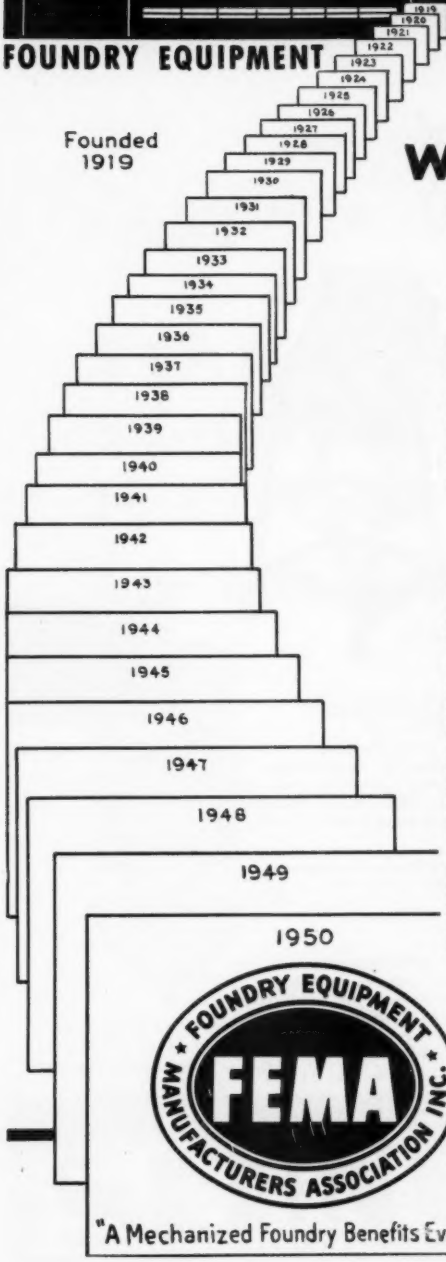

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- Disseminates progress reports
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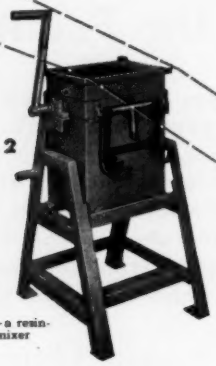
4 Steps to faster production
better metal yields
finer surface finish
more accurate detail

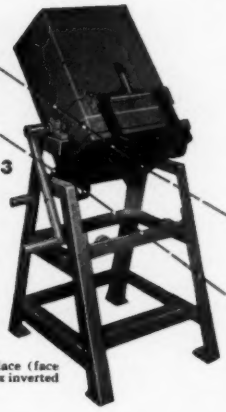
1

The face of a steel pattern



2

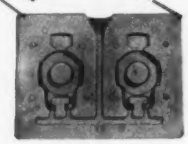
The "dump-box"—a resin-sand reservoir, or mixer



3

The pattern in place (face in) and dump-box inverted

Typical equipment used in laboratory evaluation of shell molding process.



4

The shell half—sand and Resinox

new shell molding process

In the revolutionary new Shell Molding ("C") Process, Monsanto's Resinox phenolic resins are used to produce thin, extremely light-weight foundry molds. Besides speeding production and providing better metal yields (above), Resinox and the new process provide other important advantages you'll want to investigate:

1. Castings with a superior finish
2. Castings with dimensional accuracy comparable to that achieved with precision casting techniques—excellent castings of intricate shapes and thin sections
3. Castings requiring little or no cleanup
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Monsanto also produces a wide range of other Resinox phenolic resins used by many foundries to improve cores and reduce baking cycles (and thus boost production) up to 50 per cent. For more information about the new Shell Molding Process, and for data on Resinox for shell molds and core bonding, please use the coupon below. Resinox: Reg. U. S. Pat. Off.

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☐ Please send me information on Resinox for _____

Name & Title _____

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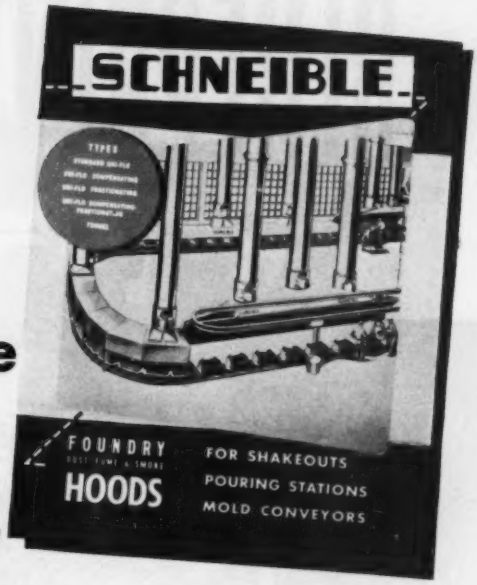

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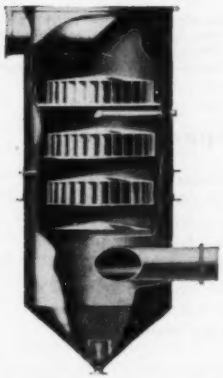

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A section is devoted to standard hood numbers with diagrams and tables of dimensions which will prove helpful in determining requirements for most usual foundry layouts.

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Above: In this complete installation of National Equipment, roller conveyors are used for mold storage and through pouring to shakeout point. Sand is returned on belt conveyor to preparing plant.

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HERE is long range foundry planning made easier and more accurate with a minimum initial equipment investment.

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Consult a National Engineer about the advantages of a National Progressive Sand Preparing Plant for your foundry. His years of specialized experience are available to you without obligation.

Write for the "National Progressive Plant" Booklet TODAY . . . see how progressive planning can save you money and effort.

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IS THIS WHERE WE CAME IN?

PRESENT PREPARATION for the defense of our country prompts many of us in the foundry industry to look back a decade. At first we may be inclined to say: "This is where we came in." But reflection reveals many differences.

On two occasions in 1941 representatives of the armed forces told our industry that we were no longer needed . . . that to serve our nation best we should convert our plants to some other line of manufacture! The acknowledged importance of the foundry industry before the war was over showed that the armed services and manufacturers had awakened to the broader usefulness of cast products.

What have we done to bring about this change and to keep up with the high production demands that eventually were made? Since 1940 we have invested over $1 billion in new plants and equipment. We have increased our productivity through modernization from 10 million to 16 million tons per year, and presently possess an annual potential of 20 million tons. Radically-new devices that were dreams and experiments in 1940 are now in use. Automatic molding machines, sand reclaiming mechanisms, the water-cooled cupola, further development of the hot blast, and refinement of the bench type core blowers are among these. Materials handling has become an important branch of foundry technology.

Die-casting, permanent molding, and even some sand cast production methods are now at the tool designer's and tool maker's level. Precision sand casting, shell molding, and investment methods have started the foundry down another new path. Improved cleaning room methods and increasing use of coatings to dress up certain castings have improved salability and utility. New engineering properties in acicular and nodular irons, aluminum and magnesium casting alloys, cast-weld steel construction, cast armor, and advanced heat treatments have expanded the castings market. The centrifugal process has taken over in the pressure pipe field and has added to the quality and quantity of our ordnance production.

Machinability research is uncovering many facts leading to lower costs in favor of increased castings use. Lower-grade and higher-cost raw materials are forcing development of new techniques such as basic cupola melting and increased use of electric melting for both alloy and super-heat cycles. More and more foundries are adopting quality control techniques. The neglected field of casting design is coming into sharper focus.

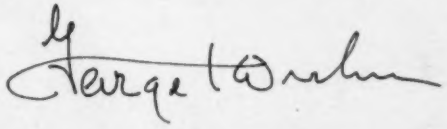
Other challenges are developing which call for ever increasing technical and managerial ability. Raw materials are becoming scarce and some degree of substitution for both metals and fuels will be one of the problems of the next decade.

Technical and managerial manpower is being augmented through the efforts of the industry leaders who created the Foundry Educational Foundation. Several hundred men from our industry are helping with this engineering college work and increasing thousands of students are receiving friendly and instructive contact with the foundry industry.

In 1940 we were viewed by some as an "old and dying industry." Today it is evident that we are young and growing in many new directions.

The foundrymen of 1940 who refused to accept the fate that others laid out for them are responsible for the momentous changes of the past decade. Following in their footsteps are the sons of foundrymen and many others who have seen the frontiers of the castings industry reveal themselves as never before. There is new faith and confidence within us.

This is not where we came in—this is a new show!



GEORGE K. DREHER
Executive Director
Foundry Educational Foundation

Long interested in foundry educational problems, George K. Dreher has been executive director of the Foundry Educational Foundation, with headquarters in Cleveland, since 1947. A past national director of A.F.S., he has participated in chapter and national committee activities and has spoken at a number of local, regional, and national meetings on education and on brass and bronze casting. He served as plant manager and later as vice-president in charge of operations of Ampco Metal, Inc., Milwaukee, from 1930 to 1946 and during that period held several offices, including the presidency, in the A.F.S. Wisconsin Chapter. He was vice-president and general manager of Rogers Pattern & Foundry Co., Los Angeles, Calif., in 1946 and 1947.

Convention News

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They have been working with us about
or two years and realize "The Foundry
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P HALE: Do they see more possibility of pro-
ion in the foundry than in the office?

HENRY LOUETTE: Yes, and an advantage of bringing the boys in from the office is that they then have a knowledge of the usual complaints from the shop and they will therefore be more understanding employees.

What Is Training Objective?

G. L. W... seems to me that one of the problems y... training is about certain

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A SCOTTISH SWORD DANCE BY TWO HIGHLAND LASSIES WAS A FEATURE ATTRACTION AT THE ANNUAL CANADIAN DINNER.

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Director-Elect Frederick G. Sefing
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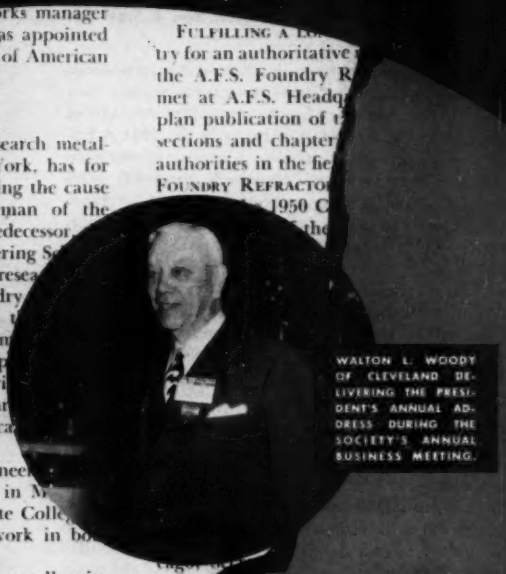
JAMES C. ZEDER, CHRYSLER CORP., DETROIT, RIGHT, RECEIVES A CERTIFICATE AND GIFT UPON COMPLETION OF HIS 1951 HOYT LECTURE FROM GOSTA VENNERHOLM, FORD MOTOR CO., HOYT LECTURE CHAIRMAN.

Story...



WALTON L. WOODY OF CLEVELAND DELIVERING THE PRESIDENT'S ANNUAL ADDRESS DURING THE SOCIETY'S ANNUAL BUSINESS MEETING.

Importance of organizing and applying information we now have might well have been part of a theme for the 1951 A.F.S. Annual Foundry Congress held in Buffalo, N.Y., April 23-26. The principle was expressed by Dr. Kenneth McFarland, superintendent of schools, Topeka, Kan., principal speaker at the Society's Annual Banquet climaxing the Convention, in calling for application of some old rules of moral conduct to today's new situation in which the United States is for the first time maintaining a huge military establishment during peace.

Over 3,000—a record registration for a non-exhibit year Convention—heard some 100 speakers tell how to apply existing foundry technical information and describe investigations leading to new conclusions on which the technology of tomorrow's foundry operations will be based. Traditional events combined with new technical meetings to make this year's A.F.S. Annual Convention the most outstanding non-exhibit Foundry Congress held.

Exemplifying another phase of an unofficial Convention theme was the feature technical paper, "The Management of Industrial Research"—the Hoyt Annual Lecture—by James C. Zeder, director of engineering and research, Chrysler Corp., Detroit. Industrial research, essential to progress in today's highly competitive economy, he declared, is summed up in: "To pioneer is to make mistakes; not to pioneer is to fail."

Typical of the papers describing technical pioneering was E. S. Renshaw's (Ford Motor Co., Ltd. Dagenham, England) "Basic Cupola Melting

AMERICAN FOUNDRYMAN reporters for the 55th Annual A.F.S. Convention were Hiram Brown, Solar Aircraft Co., Alfred H. Hesse, R. Lavin & Sons, Inc., Gordon W. Johnson, Armour Research Foundation, Guy A. Pealer, General Electric Co., Kenneth H. Priestley, Vassar Electroloy Products, Inc., William H. Ruten, Polytechnic Institute of Brooklyn, Clyde A. Sanders, American Colloid Co., Robert P. Schauss, Illinois Clay Products Co., E. C. Troy, and Wilfred H. White, Jackson Iron & Steel Co.

and Its Possibilities," the 1951 official exchange paper from the Institute of British Foundrymen. Other meetings were highlighted by the popular Shop Courses and Round Table Luncheons which emphasized operating techniques while the all-day symposium (new this year) on *"Principles of Gating"* combined reports on research and operating experiences in the casting of all the basic alloys.

Interpretation of regulations on equipment, supplies, and raw materials, and how to secure them under present and future control plans were outlined at the Foundry Equipment and Supplies Luncheon and the Defense Production Luncheon. These, along with Educational Division meetings and the 28th Annual A.F.S. Apprentice Contest, rounded out a four-day program based on the best old and new ideas about materials, methods, and men.

At the Annual Business Meeting, Wednesday, April 25, National President Walton L. Woody, National Malleable & Steel Castings Co., Cleveland, announced that the A.F.S. Building Fund had reached $128,000, surpassing the three year goal of $100,000 in less than a year. Prof. George J. Barker, University of Wisconsin, chairman of the Educational Division, reported on educational activities of the Society as a prelude to the presentation by President Woody of awards to the five first place winners in the 1951 A.F.S. Apprentice Contest (page 60). Election of national officers and directors was completed (page 52) with Walter L. Seelbach, Superior Foundry, Inc., Cleveland, being declared national president, and I. R. Wagner, Electric Steel Castings Co., Indianapolis, Ind., vice-president.

Secretary-Treasurer Wm. W. Maloney announced at the Annual Business Meeting that the 1952 A.F.S. Convention will be an International Foundry Congress, in Atlantic City, N. J. Exhibits and technical sessions will run for a week, starting on Thursday, May 1, and ending on Wednesday May 7.

Robert Ronceray, Ph. Bonvillain y E. Ronceray, Seine, France, presented greetings of Association Technique de Fonderie de France, to the American Foundrymen's Society.

At the Annual Banquet, Thursday, April 26, A.F.S. Gold Medal and Honorary Life Memberships were presented to foundry industry technical leaders. Recipients of the awards and those who made the presentations are pictured on pages 46-47. E. W. Beach, who was unable to attend, was represented by George W. Cannon, who accepted an Honorary Life Membership on his behalf from National Director James Thomson, Continental Foundry & Machine Co., East Chicago, Ind.

Throughout the week a Plant Visitations Committee headed by Joseph H. Sander, Tonawanda Electric Steel Casting Corp., North Tonawanda, N. Y., arranged for interested Convention attendants to see operations at 17 plants in Buffalo and nearby industrial centers. A.F.S. divisions and committees sand-

Greatest non-exhibit year Convention attendance in A.F.S. history was recorded at the 55th Foundry Congress of the American Foundrymen's Society. More than 3,000 technical and operating men, equipment manufacturers and suppliers registered for the Convention and swelled its technical sessions, luncheons, dinners, social events and housing to capacity. Over 1300 took advantage of the opportunity to register in advance and were able to "walk right in."

AMERICAN FOUNDRYMAN

Technical highlight of the 55th A.F.S. Foundry Congress was an all-day Symposium on "Principles of Gating," held Tuesday, April 24, in the Ballroom of the Statler Hotel, Buffalo. An estimated 1500 foundrymen, largest number ever to participate in an A.F.S. Convention technical session, attended the Symposium, which was sponsored jointly by the Society's Aluminum & Magnesium, Brass & Bronze, Gray Iron, Steel and Malleable Divisions.

wiched business and technical meetings into a busy Convention schedule. And ladies had a four-day round of social events and sightseeing trips which included a reception and tea, a luncheon and antique jewelry exhibit, a trip to Niagara Falls, and the Annual Banquet.

Most colorful event of this year's Convention was the Canadian Dinner with entertainment by a stirring pipe band and kilted dancers. National Director J. J. MacFadyen, Galt Malleable Iron Co., Galt, Ont., presided.

Special Convention events included the Alumni Dinner and the Past President's Luncheon. The Alumni Dinner, for past and present officers and directors of the Society, gold medalists and honorary life members, featured Kenneth L. Wilson, National Collegiate Athletic Association (Big Ten), who spoke on athletics and showed color motion pictures of the last Tournament of Roses parade and football game. E. W. Horlebein, Gibson & Kirk Co., Baltimore, Md., immediate past president, and C. E. Hoyt, retired executive vice-president, secretary of the A.F.S. Alumni, presided.

During the 55th Annual A.F.S. Convention annual meetings and elections were held by the National Castings Council and the Foundry Educational Foundation. Elected board chairman of FEF was Claude B. Schneible, Claude B. Schneible Co., Detroit, who was president last year. New FEF president is John M. Price, Ferro Machine & Foundry Co., Cleveland. New officers of the National Castings Council are, president, C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago, and, vice-president, A. V. Martens, Pekin Foundry & Mfg. Co., Pekin, Ill.

Other organizations which met at this year's Convention were Foundry Equipment Manufacturers' Association, National Foundry Association, and Non-Ferrous Founders' Society.

Technical activities of the 55th Annual A.F.S. Convention started with four simultaneous sessions sponsored by the Heat Transfer Committee, the Aluminum and Magnesium Division, the Malleable Division, and the Brass and Bronze Division. At the heat transfer meeting, W. K. Bock presented a paper he co-authored with H. A. Schwartz, National Malleable & Steel Castings Co., Cleveland, entitled *"Freezing of White Cast Iron in Green Sand Molds."* Discussion centered about the controversial Chvorinov's volume to area relationship, the authors contending evidence failed to support a straight line relation of solidification and time. It was pointed out that the V/A ratio of Caine was not the V^2/A^2 ratio advocated by Chvorinov with which it should not be confused.

V. Paschkis, Columbia University, gave a progress report on the Heat Transfer Research Project sponsored by the Society in his paper *"Heat Flow in Moist Sand."* The report outlined the complex heat flow phenomena which occur in green sand and emphasized

A service to executives and men of the foundry trade associations who had expressed interest in a meeting of this kind was the Defense Production Luncheon. Luncheon headliners were, left to right: John A. Claussen, NPA Pig Iron Section chief; A. J. McDonald, chief, Castings Section, Iron & Steel Div., NPA; Lieut. Comdr. William A. Meissner, Bureau of Ships; A.F.S. Vice-President Walter L. Seelbach; Nigel Bell, director, Light Metals Division, NPA; and A.F.S. Past President Edwin W. Horlebein of Gibson & Kirk Co., Baltimore, Md.

NPA officials and the men who provide the tools for the foundry industry met at the Foundry Equipment & Supplies Luncheon, April 24, to work out mutual problems. Pictured here are, left to right: F. B. Flynn of Chicago, president, Foundry Facings Manufacturers' Association; Speaker Aubrey J. Grindle, director, Foundry Equipment & Supplies Section, NPA; C. V. Nass of Chicago, president, Foundry Equipment Manufacturers' Association; Speaker Thomas Kaveny, Jr., consultant Foundry Equipment & Supplies, NPA.

the relatively great importance of moisture during the very early intervals of solidification in comparison to its small importance later. H. A. Schwartz presided and E. C. Troy, Palmyra, N. J., was co-chairman.

L. W. Eastwood, Battelle Memorial Institute, Columbus, Ohio, described furnaces and their selection, use, and maintenance in his paper *"Melting Aluminum and Magnesium-Base Alloys."* If molten aluminum contains as little as 2 ml of hydrogen per 100 grams of metal and 1 ml is liberated at solidification, 6.7 per cent voids can occur in the metal, he said. Round pinholes form if gas is released while the metal is liquid and angular, jagged pinholes form if the metal is partially solidified. Hydrogen absorbed from mold moisture shows a gradation in pinhole porosity which decreases toward the center of the casting.

"Fluid Mechanics Applied to Founding," by W. O. Wetmore and D. S. Richins, U. S. Naval Ordnance Test Station, Pasadena, Calif., was presented by Richins. Tests reported showed that fluid flow equations based on water were valid for calculating flow of aluminum. Using such data, the authors poured several hundred aluminum alloy castings with only 8 per cent loss using a ¼ in. wide slot sprue. Castings made by dropping 700 lb of alloy 4½ ft into a mold withstood 500 psi hydraulic pressure without impregnation. They found the round, tapered sprue to be best.

J. J. Warga, Piasecki Helicopter Corp., and P. J. Scherbner, Sperry Gyroscope Corp., Great Neck, Long Island, N. Y., were co-chairmen.

Alfred H. Hesse, R. Lavin & Sons, Inc., Chicago, presented *"Refining Secondary Copper Alloys,"* which he co-authored with Marvin Glassenberg and L. F. Mondolfo, Illinois Institute of Technology. Presented for the first time were data on removal of aluminum, silicon, phosphorus, manganese, iron, and zinc from brass by air and oxygen injection. Oxygen injection did not prove advantageous, in spite of the theoretical implications in its favor.

"Radiography as an Assistant to Foundry Practice," by S. A. Brosky, Pittsburgh Testing Laboratory, and C. B. Johnson, Rockwell Mfg. Co., Pittsburgh was presented by Brosky. He described a system for radiographing 5 per cent of each shipment of pressure castings which provided the basis for accepting or rejecting the entire shipment.

J. O'Keefe, Jr., Exomet, Inc., Conneaut, Ohio, summarized techniques for increasing riser efficiency by use of chills and insulating materials in his paper *"Riser Efficiency Increased by Insulation."* Soundness as well as yield are increased, he said, and there is considerable advantage with high shrinkage metals such as copper, manganese bronze, and aluminum bronze.

Presiding at the brass and bronze session was W. B. Scott, National Bearing Div., American Brake Shoe Co., Meadville, Pa. Co-chairman was H. G. Schwab, Bunting Brass & Bronze Co., Toledo, Ohio.

At the opening malleable session, E. J. Jory, National Malleable & Steel Castings Co., Cicero, Ill., listed the following corrective measures in his paper *"Malleable Core Practice as Related to Foundry Los-*

A featured event of the Ladies' Entertainment program was a Reception and Tea in the Georgian Room of the Hotel Statler Monday afternoon, April 23. Pouring is Mrs. Walton L. Woody, First Lady of A.F.S.

ses": hot tears—reduce resistance to metal contraction through core weight control, use a 20-mesh sawdust filler, use minimum moisture; strain cracks—not attributable to cores but to length of shakeout time; core scabs and cuts—intergranular expansion of sand, corrected by at least 20 per cent by weight of silica flour. He covered also, core blows, penetration and rough surfaces, dirty castings, dimensional factors, shrink, and misruns and cold shuts.

In *"Modern Core Sand Practice,"* R. H. Greenlee, Auto Specialties Mfg. Co., St. Joseph, Mich., described use of thermosetting resins or highly polymerized oils to achieve fast baking and higher production with limited oven facilities. Phenolic resins bake 30 to 50 per cent faster than usual oils and migrate to the core surface with resultant increase in hardness. Fast baking, highly polymerized core oils, properly mixed and worked at 2.0-2.5 per cent moisture will bake as fast as thermosetting resins, he declared.

E. C. Zirzow, Deere & Co., Moline, Ill., and F. J. Pfarr, Lake City Malleable Co., Cleveland were chairman and co-chairman of the meeting, respectively.

At the Aluminum and Magnesium Round Table Luncheon, O. Z. Rylski, Department of Mines and Technical Surveys, Ottawa, Ont., Canada, led a discussion on centrifugal casting of light alloys. R. F. Cramer, General Electric Co., Schenectady, N. Y., presided; J. W. Meier, of the Department, was co-chairman. Reviewing the work done by the Department, Rylski said that while centrifugal casting was 150 years old it had only been applied in the light metal field for the past 6 years. Dry sand mixtures and mold coatings had to be developed to resist the washing of the metal and speeds of 800 rpm are now possible, he stated. Low initial speed with gradual acceleration after pouring gives best results. Gating geometry was found to be important, with various shapes and sizes of gates needed for different speeds.

Using a new technique of discussion by tables, instead of general discussion from the floor, the Brass and Bronze Round Table Luncheon evoked so much interest that only five of 16 topics proposed were covered. B. A. Miller, Baldwin-Lima Hamilton Corp., Eddystone, Pa., and H. L. Smith, Federated Metals Div., American Smelting & Refining Co., Pittsburgh, presided. Discussion covered melting temperatures, synthetic sands, melt quality from various types of furnaces, test bars, and insulating riser sleeves.

At an early afternoon session sponsored by the Educational Division, R. W. Schroeder, University of Illinois, Chicago, called for more cooperation between educational institutions and industry in his paper, *"Development of Foundry Courses in High and Trade Schools."* He proposed local committees of foundrymen to work with the schools and a course of study which schools could adopt to meet the needs of the foundry industry.

Second speaker was T. W. Russell, Jr., American Brake Shoe Co., New York, who outlined his com-

Getting together to talk shop just before the Steel Round Table Luncheon, Thursday, April 26, were left to right, standing: A.F.S. National Director V.E. Zang, Unitcast Corp., Toledo, Ohio, luncheon chairman; and C. W. Briggs, Steel Founders' Society of America. Seated: Bruce F. Richardson, Steel Castings Institute of Canada, Ottawa, Ont.; D. F. Sawtelle, Malleable Iron Fttings Co., Branford, Conn.

Co-chairmen of the highly successful Symposium on "Principles of Gating," held all day Tuesday, April 24, and sponsored jointly by five A.F.S. Divisions, were, left to right: George P. Halliwell, H. Kramer & Co., Chicago, Brass & Bronze; Fred J. Walls, International Nickel Co., Detroit, Gray Iron; Symposium Chairman R. F. Thomson, Research Laboratories Div., GMC, Detroit; Symposium Co-Chairman Hiram Brown, Solar Aircraft Corp., Des Moines, Iowa; W. S. Pellini, Naval Research Laboratory, Washington, D. C., Steel; and Walter E. Sicha, Aluminum Corp. of America, Cleveland, Aluminum & Magnesium. Not shown in photograph is Robert P. Schauss, Illinois Clay Products Co., Chicago, representing Malleable Div.

General Convention Chairman Alfred A. Diebold, Atlas Steel Castings Co., Buffalo, (center) chairman of the Convention host chapter, and Mrs. Diebold welcome two foundrymen from Sweden to the Convention. At left is Carl-Gustaf Soderlund, general foundry manager, and at right Bertil Tyberg, chief metallurgist, both of the Husqvarna Vapenfabriks, Sweden.

pany's apprentice training program. It is one of learning by doing, he said, and is flexible enough to build upon what the apprentice knows before entering training. W. H. Ruten, Polytechnic Institute of Brooklyn, N. Y., was chairman; co-chairman was George J. Barker, University of Wisconsin.

The second heat transfer session, with Messrs. Schwartz and Troy as co-chairmen, featured two Naval Research Laboratory papers, *"Solidification of Steel Against Sand and Chill Walls,"* by H. F. Bishop, F. A. Brandt, and W. S. Pellini, and *"Solidification of Gray Iron in Sand Molds,"* by R. P. Dunphy and W. S. Pellini. The first paper, presented by Pellini, provided operating data of excellent compatibility with mass flow analyzer data previously reported by V. Paschkis.

In presenting the second paper, Dunphy outlined an interesting wave concept of solidification. He described the effect of superheat, carbon equivalent, and sea coal, pointing out that sea coal speeds solidification, the effect being of the order of 15 per cent decrease in solidification time.

At a simultaneous session sponsored by the Malleable Division, J. E. Rehder, Canadian Department of Mines and Technical Surveys, delivered a paper entitled *"The Relative Effects of Chromium and Silicon Contents on Rate of Anneal of Black-Heart Malleable Iron."* He showed that chromium neutralizes the graphitizing effect of from four to five times its weight of silicon. His charts showed how to determine the necessary changes in first stage annealing practice and silicon content to overcome chromium effects.

Second malleable session speaker was R. W. Heine, University of Wisconsin, who presented the theoretical half of a paper, *"Oxidation-Reduction Principles Controlling the Composition of Molten Cast Irons."* In the following session he reported on operating aspects of his work. Heine described the principal oxidation-reduction reactions of carbon, silicon, and manganese. At 2375 F, he said, silicon oxidizes first, followed by carbon. At 2600 F silicon starts to oxidize while carbon goes at the same time, but more slowly. Carbon drops rapidly at 2730 F and silicon remains constant until carbon has been reduced to about 1.0 per cent, he stated. Manganese is little affected through these temperatures. Carbon oxidation is more rapid at 2825 F and is accompanied by a silicon pickup.

Presiding at the early afternoon malleable session was C. F. Lauenstein, Link-Belt Co., Indianapolis, Ind., with F. Coghlin, Jr., Albion Malleable Iron Co., Albion, Mich. as co-chairman. At the session immediately following, W. D. McMillan, International Harvester Co., Chicago, was chairman; Wm. Zeunik, National Malleable & Steel Castings Co., Indianapolis, Ind., was co-chairman.

Speakers' table occupants at the Educational Dinner, held the evening of Monday, April 23, in the Hotel Statler's Empire State Room were, standing, left to right: Claude B. Schneible, Claude B. Schneible Co., Detroit; S. C. Wasson, National Malleable & Steel Castings Co., Chicago; Dean C. J. Freund, University of Detroit; and George K. Dreher, executive director, Foundry Educational Foundation. Seated, left to right: A.F.S. Educational Division Chairman George J. Barker, University of Wisconsin; A.F.S. National Vice-President Walter L. Seelbach; Collins L. Carter, Albion Malleable Iron Co., Albion, Mich.; and A.F.S. National President Walton L. Woody, Cleveland.

Patternmaking notables attending the Pattern Round Table Luncheon Wednesday, April 25, included, standing, left to right: A.F.S. National Director V. J. Sedlon, Master Pattern Co., Cleveland; Frank Cech, Cleveland Trade School; and E. T. Kindt, Kindt-Collins Co., Cleveland. Seated: Vaughan Reid, City Pattern Foundry & Machine Co., Detroit; A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee; Chairman Leonard F. Tucker, City Pattern & Foundry Co., South Bend, Ind.; and Speaker W. H. Dashiell of Kindt-Collins Company.

Continuing with his paper, Heine reported on the commercial approach with a study of two cold melt furnaces. A silicon pickup of 0.04 to 0.29 per cent was reported in 60 per cent of the heats. Slag with sufficient iron oxide may cause reversal of the silicon pickup, he said. Loss of manganese occurs during meltdown, but further loss is very small.

Discussion brought out that control of the factors influencing silicon pickup is in the hands of the furnace operator. Scatter is usually wide, it was stated, resulting in mottle and variation in properties.

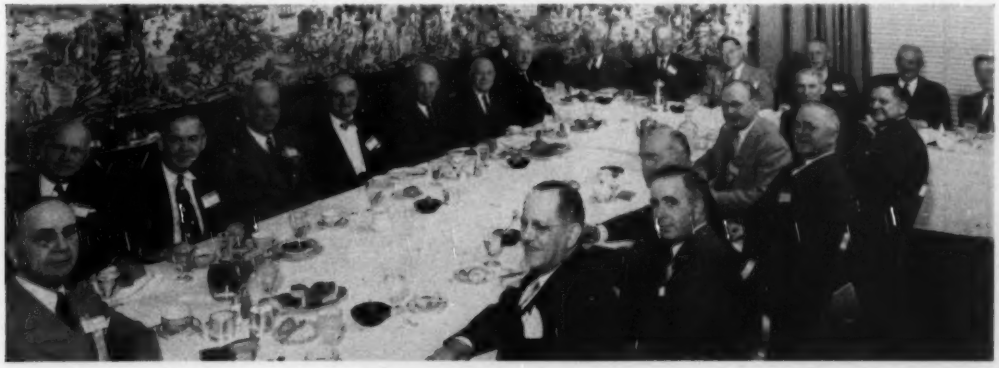
O. E. Cullen presented the paper, *"Malleable Cast Iron Annealing Furnaces and Atmospheres,"* coauthored with R. J. Light, Surface Combustion Corp., Toledo, Ohio. The paper reviewed annealing of white iron and furnace atmospheres covering manufactured and self-developed atmospheres. Effect of high hydrogen content in increasing annealing time was stressed. Discussion developed that preferred atmosphere was two parts CO to one part CO_2.

The late aluminum and magnesium session included the official exchange paper from the Institute of Australian Foundrymen, *"The Modification Technique of Aluminum-Silicon Alloys,"* by R. H. Dyke, Defence Research Laboratories, Marybirnong, Victoria, Australia, and papers by R. C. Cornell, Litemetal Diecast, Inc., Jackson, Mich., and K. E. Nelson and F. P. Strieter, Dow Chemical Co., Midland Mich. M. E. Brooks, of Dow, presided, and W. D. Danks, Howard Foundry Co., Chicago, was co-chairman.

In his paper, *"Magnesium as a Die Casting Material,"* Cornell, stated that the material has a lower heat content than aluminum at the same temperature which makes running long sections difficult but which speeds the casting cycle. A slippery metal compared with aluminum, Cornell said, cores are easier to withdraw from magnesium without scuffing the casting.

Nelson described development of several magnesium-rare earth alloys without zirconium for use in jet engine applications in the paper, *"Castability and*

Guiding lights of A.F.S., past and present were caught by the photographer at the Annual Past Presidents' Breakfast April 26. From lower left, going clockwise around table, are: Past Presidents Ralph J. Teetor (1944) and James L. Wick, Jr. (1936); A.F.S. National Secretary-Treasurer Wm. W. Maloney; A.F.S. National President Walton L. Woody; Past Presidents H. Bornstein (1937), W. R. Bean (1920-1922), Dr. G. H. Clamer (1923); N. K. B. Patch (1930); Secretary Emeritus R. E. Kennedy; Past Presidents Benjamin D. Fuller (1917), Wm. H. McFadden (1906), W. B. Wallis (1948), L. L. Anthes (1909), Henry S. Washburn (1939); A.F.S. Executive Vice-President (retired) C. E. Hoyt; Past Presidents Herbert S. Simpson (1941), L. N. Shannon (1940), Fred J. Walls (1945), Edwin W. Horlebein (1949) and Marshall Post (1939); A.F.S. National Vice-President Elect I. R. Wagner; and A.F.S. National President Elect W. L. Seelbach.



Convention Plant Visitation Committee Co-Chairman Walter Hunsicker, Worthington Pump & Machinery Corp., Buffalo (smoking), and Chairman Joseph H. Sander, Tonawanda Electric Steel Casting Corp., North Tonawanda, N. Y., help two visiting foundrymen to plan tours through the many Buffalo plants open for inspection to 55th A.F.S. Foundry Congress visitors.

Property Comparison of Several Magnesium-Rare Earth Sand Casting Alloys." Absence of zirconium resulted in better strength at 600 F, he declared, but elongation at all temperatures from room temperature to 600 F was low.

Walter Sicha, Aluminum Co. of America, Cleveland, presented Dyke's paper in his absence. The paper pointed out that over-modification forms an Al-Si-Na constituent which destroys some of the beneficial effects. Fracture tests are good indicators of success of modification technique, it was reported, and sodium is the best modification agent but calcium will also work.

B. N. Ames, New York Naval Shipyard, Brooklyn, presided at the late afternoon brass and bronze session. Co-chairman was John W. Bolton, Lunkenheimer Co., Cincinnati. Clyde L. Frear, Bureau of Ships, Dept. of Navy, Washington, D. C., delivered a paper entitled *"U. S. Navy Non-Ferrous Development Program."* He outlined a rapid test for the determination of melt quality, including some work with the fracture test developed under A.F.S. sponsorship at the University of Michigan. Other studies mentioned included molding materials, radiographic standards, and mechanism of interdendritic shrinkage.

R. D. Shelleng and F. B. Rote reported on their work with C. Upthegrove on the A.F.S. research at Michigan in a paper entitled *"Melt Quality and Fracture Characteristics of 85-5-5-5 Red Brass and 88-8-4 Bronze."* Colored slides showed melt quality can be determined in three minutes from color and texture of a fractured chill test specimen. Several foundries reported that the test was successful in cases where rigid melting control was required but that some revision is necessary.

At the Educational Division's dinner the end of the first day, George J. Barker, University of Wisconsin, and G. K. Dreher, Foundry Educational Foundation, Cleveland, presided. C. J. Freund, University of De-

Speakers' table occupants at the Malleable Round Table Luncheon April 24 included, left to right: W. D. McMillan, International Harvester Co., Chicago; Discussion Leader William Ferrell, Auto Specialties Mfg. Co., St. Joseph, Mich.; James H. Lansing, Malleable Founders' Society, Cleveland; Malleable Division Chairman George E. Bean, Eastern Malleable Iron Co., Wilmington, Del.; Carl F. Lauenstein, Link-Belt Co., Indianapolis; and Russel J. Anderson, Belle City Malleable Iron Company, Racine, Wisconsin.

troit, stated in his address, *"What the College Graduate Can Do for the American Foundryman,"* that the foundry industry needs engineering colleges in the same way that the medical profession needs medical schools. Continuing his parallel, he pointed out the need for an industrial internship which will give the engineering graduate a practical insight into foundry industry problems.

In his paper, *"Absorbing the Technical Trainee in Industry,"* Collins L. Carter, Albion Malleable Iron Co., Albion, Mich., emphasized the need for recruiting engineering graduates as other industries do to make sure these men do not get into other fields before they've heard about opportunities in the foundry.

The series of Shop Courses started the evening of Monday, April 23, with sessions sponsored by the Brass and Bronze Division, the Gray Iron Division, and the Sand Division. Heavily attended, the shop sessions gave foundrymen an opportunity to compare practical shop experiences on an informal basis.

Harry W. Dietert, Harry W. Dietert Co., Detroit, led a discussion on *"Basic Approach to Sand Control for Copper Base Alloys."* Presiding were W. W. Edens, Badger Brass & Aluminum Foundry Co., Milwaukee, and G. P. Halliwell, H. Kramer & Co., Chicago.

Discussion at the Gray Iron Shop Course was led by D. E. Krause, Gray Iron Research Institute, Inc., Columbus, Ohio. The topic was *"Air in the Cupola."* W. W. Levi, Lynchburg Foundry Co., Radford, Va., and E. J. Burke, Hanna Furnace Co., Buffalo, were co-chairmen. *"Malleable Foundry Sand Control"* was the discussion subject at the Sand Shop Course, with Earl E. Woodliff, Foundry Sand Service Engineering Co., Detroit, as leader. Frank S. Brewster, Harry W. Dietert Co., Detroit, presided; co-chairman was E. L. Thomas, Cadillac Motor Car Co., Detroit.

Tuesday, April 24

Largest number of foundrymen ever to attend a single A.F.S. Convention technical session, estimated as high as 1500, were present at the day-long Symposium on *"Principles of Gating,"* sponsored jointly by the A.F.S. Aluminum & Magnesium, Steel, Brass and Bronze, Gray Iron, and Malleable Divisions.

Presiding at the Symposium was R. F. Thomson, Research Laboratories Div., General Motors Corp., Detroit. Co-chairmen of the Symposium, each presiding over his own division's part of the program, were: *Aluminum & Magnesium,* Walter E. Sicha, Aluminum Co. of America, Cleveland; *Steel,* W. S. Pellini, Naval Research Laboratory, Washington, D. C.; *Brass and Bronze,* George P. Halliwell, H. Kramer & Co., Chicago; *Gray Iron,* Fred J. Walls, International Nickel Co., Detroit; and *Malleable,* Robert P. Schauss, Eastern Clay Products, Inc., Chicago.

Making last-minute preparations for the Monday morning Heat Transfer Session were, left to right (seated): Chairman H. A. Schwartz, National Malleable & Steel Castings Co., Cleveland, and A.F.S. National Director E. C. Troy, Palmyra, N. J., foundry consultant. Standing, left to right: Speakers Victor Paschkis, Columbia University, and W. K. Bock of National Malleable & Steel Castings Co., Cleveland.

Chairman Thomson opened the Symposium at 9:00 a.m., stating that the Symposium was designed to help establish good gating practices common to the casting of all types of metals, and to present the latest research and practical developments.

Opening speaker of the Symposium, representing the Aluminum & Magnesium Division, was L. W. Eastwood of Battelle Memorial Institute, Columbus, Ohio, who spoke on *"Tentative Design of Horizontal Gating Systems for Light Alloys."* Evidence indicates that good gating practice is essentially the same for all metals, Mr. Eastwood said, but some metals can allow more deviation from this standard, yet produce

At the Convention to renew old friendships were the widows of three late members of the "Official Family." Welcoming Mrs. Fred Erb (National President 1930), Mrs. S. Wells Utley (National President 1928), and Mrs. Fred L. Wolf (Gold Medalist 1941) is their longtime friend C. E. Hoyt, A.F.S. Alumni secretary, retired executive vice-president of the Society.

more satisfactory castings than will other metals. In general, he said, good practice involves use of pouring basin with rounded lips at sprue, and, a tapered sprue with a top two or three times the diameter of the bottom. Base diameter of the sprue is a primary consideration, he said, and the sump at the base of the sprue should be two or two-and-a-half times the diameter of the sprue with the runner restricted after the sump. Too-large sprues, he said, are a common foundry fault. Mr. Eastwood concluded by stating that gates should be taken off in a curve to prevent abrupt changes in cross-sectional area and the cross-section of each runner should be reduced by the area of the gate each time a gate is passed.

Brass and Bronze Division speaker Arthur K. Higgins, Allis-Chalmers Mfg. Co., Milwaukee, speaking on *"Considerations in the Feeding of Castings,"* described the mechanism by which long-freezing-range alloys solidify in a mold, as compared to solidification of short-freezing-range alloys. Long-freezing alloys, he said, are fed with much greater difficulty because the bulk of the feed metal must penetrate through spongy areas of partially solidified metal. Pressures required to force metal through areas are controlled by a combination of temperature gradients in the mold. The freezing pattern of a casting is of considerable importance because, as the temperature drops, it affects the rate of flow. Finally, he said, because of the relationship between available feed pressure and feed demand rates, there is a critical distance beyond which feed cannot be secured unless temperature gradients are increased or additional feeding connections are supplied to divide the casting into sections of less than critical length.

56th A.F.S. Foundry Congress Atlantic City, N.J., May 1-7

Next year's A.F.S. Convention and Exhibit will be the first International Foundry Congress held in the United States since 1934. As announced in last year's "Report to the A.F.S. Membership" and in the October 1950 issue of AMERICAN FOUNDRYMAN, the site is Atlantic City, N. J., and the dates are May 1 through 7. The 1952 Congress will start on a Thursday and end on a Wednesday, providing a full week of convention sessions and exhibits. The Annual Banquet is scheduled for the middle of the period, with committee meetings and an International Reception, as well as exhibits, on Sunday, May 4. Part of the first and the last half of the period will be available for chartered plant visits.

Alfred A. Boyles, U. S. Pipe & Foundry Co., Burlington, N. J., left, admires John H. Whiting Gold Medal presented by Joseph S. Seaman Gold Medalist C. H. Lorig, Battelle Memorial Institute, Columbus, Ohio.

National Director V. J. Sedlon (left), Master Pattern Co., Cleveland, presents certificate of Honorary Life Membership in the Society to E. J. McAfee, Puget Sound Naval Shipyard, Bremerton, Wash.

Shown at the reception for those at the Annual Banquet speakers' table are: Dr. Kenneth McFarland, superintendent of schools, Topeka, Kan., principal speaker; A.F.S. National President Walton L. Woody, who presided at the banquet; and The Reverend C. George Widdifield, who delivered the invocation.

Steel Division's contribution to the morning half of the Symposium was *"Relation of Casting Quality to Gating Practice,"* by W. H. Johnson, H. F. Bishop and W. S. Pellini, Naval Research Laboratory, Washington, D. C. Speaker Johnson described how steel, gray iron, aluminum and bronzes were poured at the Naval Research Laboratory, using a number of gating methods. The castings were sectioned and x-rayed and where no swirling or excessive choking action occurred, gray iron and steel were not greatly affected by changes in gating, whereas non-ferrous alloys were sensitive to changes in gating. Certain types of sumps and radiused runners, he said, gave better results than others and excessive choking of runners caused squirting and impingement on the mold. Most satisfactory of all, Johnson concluded, were free systems and the use of moderate chokes.

Concluding speaker of the morning session, Howard F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass., presented a paper, *"Interim Report on Gray Iron Research,"* written in collaboration with W. A. Schmidt, also of MIT, as the Gray Iron Division's contribution to Gating Symposium research.

Gray iron, Prof. Taylor said, has a wide solidification range which presents complex feeding problems. Since runners and gates disturb heat balance and risers further complicate the situation, Taylor said MIT used specimens without gates or runners. Spheres of 4½-in. diameter were poured through a small hole at top center, which was plugged immediately after pouring—thus there was virtually no riser. Dry and green sand molds, he said, were used and some were rotated while others remained static. Dry sand molds were sound when sectioned, but green sand molds showed circular shrinkage when rotated. Static castings in green sand did not show circular shrinkage, he concluded.

Following a luncheon recess, the Symposium on *"Principles of Gating"* resumed at 2:00 p.m. The afternoon was devoted to discussion rather than formal papers. Each of the five participating divisions was allowed a 15-minute prepared discussion, plus 15 minutes of open discussion from the floor.

Opening the discussion program was T. E. Kramer, Wm. F. Jobbins, Inc., Aurora, Ill., representing the Aluminum and Magnesium Division. Other speakers

Alfred L. Boegehold, General Motors Research Laboratory, Detroit, right, a John H. Whiting Medalist, congratulates V. A. Crosby, Climax Molybdenum Co., Detroit, as he presents to him the John A. Penton Gold Medal. Below, T. W. Curry, Lynchburg Foundry Co., Lynchburg, Va., left, receives the Peter L. Simpson Gold Medal from 1947 Simpson Medalist R. A. Flinn, Jr., American Brake Shoe Co., Mahwah, N. J.

Spark plugs of the Brass and Bronze Round Table Luncheon Monday, April 23, were, seated, left to right: Division Chairman George P. Halliwell, H. Kramer & Co., Chicago; B. A. Miller, Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia; H. L. Smith, Federated Metals Div., American Smelting & Refining Co. Pittsburgh; and Past National President Dr. G. H. Clamer, Ajax Metal Div., H. Kramer & Co., Philadelphia. Standing, left to right: D. Frank O'Connor, O'Connor's Foundry, Inc., Hackettstown, N. J.; J. S. Vanick, International Nickel Co., New York; and Arthur K. Higgins, Allis-Chalmers Mfg. Co., Milwaukee.

representing the various divisions were: J. B. Caine, foundry consultant, Wyoming, Ohio, *Steel;* B. N. Ames, New York Naval Shipyard, Brooklyn, *Brass and Bronze;* F. G. Sefing, International Nickel Co., New York, *Gray Iron;* and Elmer C. Zirzow, Deere & Co., Moline, Ill., and C. C. Lawson, Wagner Malleable Iron Co., Decatur, Ill., for *Malleable.*

Discussions of speakers and audiences overlapped, since it appeared the problems were the same for all foundrymen. Fundamentally, shop experiments showed that gating systems recommended by the two A.F.S. *"Fluid Flow"* films were sound and with minor revisions could be applied to all metals. As a result of these systems, high-quality castings were produced in many foundries, the discussion brought out, and the only major objection to the recommended system was that it reduced metal yield.

Data presented on iron castings showed that a pouring speed of 10 lb per second is a good rate for a 250-500 lb casting, and that pouring rates should decrease proportionately with casting weight.

Case Institute of Technology reported tests made with thermocouples embedded in the mold. Effect of narrow gates was to remove hottest area far from gate entrance. With larger gates, hottest area was at the gate entrance and the coldest area was remote from the gate entrance so that progressive cooling occurred and maximum feeding was obtained.

Editor's Note: Unlike other Convention papers, the symposium on *"Principles of Gating"* papers will not appear in A.F.S. TRANSACTIONS but will be published as a separate publication later this year.

The chronological summary of events at the 55th Annual A.F.S Convention will be concluded in the June AMERICAN FOUNDRYMAN.

Beaming smiles were the order of the day as A.F.S. President and Mrs. Walton L. Woody (left) welcomed Immediate Past President and Mrs. Edwin W. Horlebein at the President's Reception preceding the 55th Convention. In background, National Secretary-Treasurer and Mrs. Wm. W. Maloney greet a lady guest.

At the Convention meeting of the A.F.S. Building Project Committee were (front row, left to right): W. B. Wallis, Pittsburgh Lectromelt Furnace Corp., Pittsburgh; G. H. Clamer, Ajax Metal Div., H. Kramer & Co., Philadelphia; E. W. Horlebein, Gibson & Kirk Co., Baltimore, Md.; Marshall Post, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; and L. P. Robinson, Werner G. Smith Div., Archer-Daniels-Midland Co., Cleveland. In the back row, left to right, are: Walter L. Seelbach, Superior Foundry, Inc., Cleveland; Walton L. Woody, National Malleable & Steel Castings Co., Cleveland; Committee Chairman Ralph J. Teetor, Cadillac, Mich.; A.F.S. Secretary-Treasurer Wm. W. Maloney, Chicago; L. N. Shannon, Stockham Valves & Fittings Inc., Birmingham, Ala.; H. S. Simpson, National Engineering Co., Chicago; T. H. Benners, Jr., T. H. Benners & Co., Birmingham, Ala.; Frank C. Riecks, Ford Motor Co., Dearborn, Mich.; I. R. Wagner, Electric Steel Castings Co., Indianapolis, Ind.; and Robert Gregg, Reliance Regulator Div., American Meter Co., Alhambra, Calif. Preliminary discussions on site and building were held.

EXCEED BUILDING FUND GOAL

OVER THE TOP in the first year of a three-year campaign, the A.F.S. Building Fund exceeded the goal of $100,000 by over $28,000 according to announcements by National President Walton L. Woody, at the A.F.S. Annual Meeting, and Building Project Committee Chairman Ralph J. Teetor, at the Annual Banquet, during the 55th Annual Convention in Buffalo. Enthusiastic response to the program, proposed only a year ago, is due to the recognition by individuals, chapters, and companies that a permanent headquarters for the Society will promote even greater service to A.F.S. and the foundry industry.

At a meeting of the Building Project Committee during the A.F.S. Annual Convention, plans and recommendations were formulated for presentation to the A.F.S. Board of Directors. Action of the Board will be reported after the directors have met.

Due to recent heavy interest in the Fund, contributions and pledges continue to come in and to be accepted on a Charter Subscriber basis. Latest additions to the list of Charter Subscribers for the period March 22 through April 26 are given below.

All A.F.S. chapters have contributed to the A.F.S. Building Fund. Individuals and firms still desiring to participate are requested to send their contributions to: American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill.

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(March 22 - April 26, 1951)

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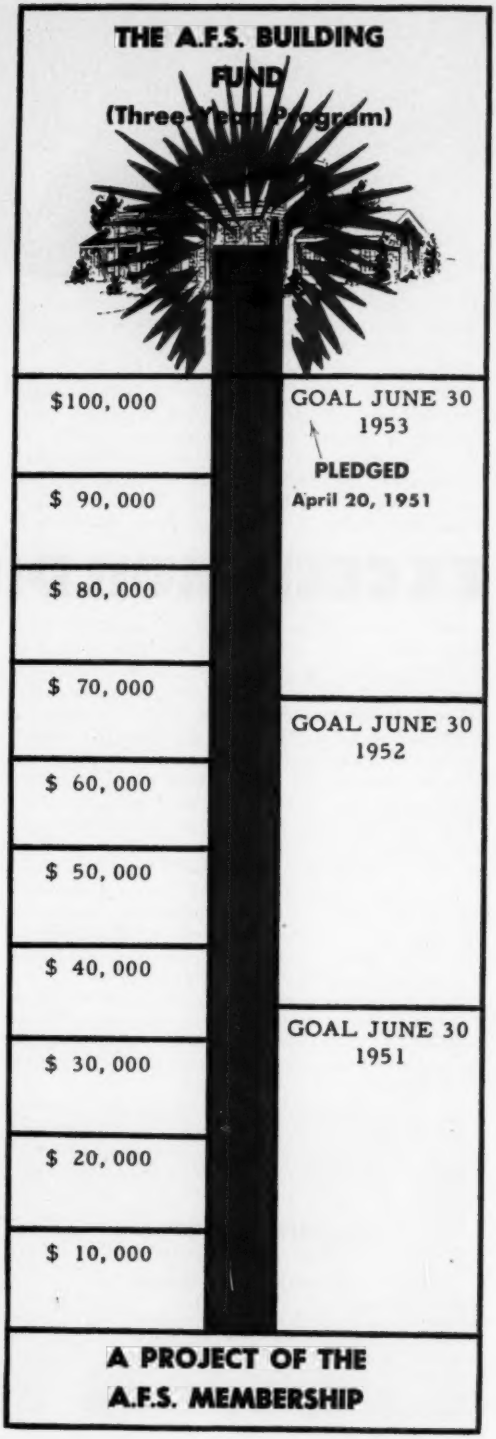

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The Wheland Co., Chattanooga.
The Wilmington Casting Co., Wilmington, Ohio.
Harry J. Winters Co., Philadelphia.

International Foundry Committees Elect '51 Presidents, Vice-Presidents

MEETING RECENTLY, members of two committees of the International Committee of Foundry Technical Associations elected presidents and vice-presidents. Named president for 1951 of the International Committee of Foundry Technical Associations is Dr. F. W. E. Spies of The Netherlands, with Dr. Engineer Guido Vanzetti of Milan, Italy, as vice-president.

International Committee on Testing Cast Iron elected Prof. Dr. Mont Frank Pisek president and Dr. Paul Bastien, Paris, vice-president.

Brass & Bronze Research Committee Names C. A. Robeck As New Chairman

MEETING EARLY this year in Chicago, the Brass & Bronze Research Committee named Clausen A. Robeck, Gibson & Kirk Co., Baltimore, as chairman, succeeding Blake M. Loring, Naval Research Laboratory, Bellevue, Wash., who has been called to active duty with the Navy.

SOCIETY ELECTS AND DIRECTORS

ELECTED PRESIDENT of the American Foundrymen's Society at its Annual Meeting, held during the 55th A.F.S. Foundry Congress in Buffalo on April 25, is Walter L. Seelbach, president and general manager, Superior Foundry, Inc., Cleveland. Mr. Seelbach, who heads the slate of 1951-52 officers and directors of the Society, served as A.F.S. National Vice-President during the 1950-51 term and will take over duties of A.F.S. National President Walton L. Woody, National Malleable & Steel Castings Co., Cleveland, following the annual Board of Directors meeting this July.

Succeeding Mr. Seelbach to the National Vice-Presidency of A.F.S. is I. R. Wagner, director, Electric Steel Castings Co., Indianapolis.

Elected to serve three year terms as National Directors of A.F.S. are:

Harry W. Dietert, president, Harry W. Dietert Co., Detroit.

Albert L. Hunt, works manager, National Bearing Division, American Brake Shoe Co., St. Louis.

Dr. James T. MacKenzie, technical director, American Cast Iron Pipe Co., Birmingham, Ala.

A. M. Ondreyco, plant manager, Vulcan Foundry Co,. Oakland, Calif.

Martin J. O'Brien, Jr., works manager, Symington-Gould Corp., Depew, N. Y.

Walton L. Woody, vice-president and general manager, National Malleable & Steel Castings Co., Cleveland, Ohio, whose term as A.F.S. National President expires this July, will continue as a director of the Society for one year.

All of the aforementioned officers and directors of the Society have long and distinguished records of service to the Society and the foundry industry.

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Cleveland, Ohio

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ALBERT L. HUNT
National Bearing Division,
American Brake Shoe Co.
St. Louis, Mo.

Walter L. Seelbach

A. F. S. National President-Elect Seelbach, in addition to serving the Society in his present capacity as National Vice-President, has been a National Director (1935-37) of A.F.S., past president of the Ohio Foundrymen's Association (1926), and was twice elected president of the Gray Iron Founders' Society.

Graduating from the Case School of Applied Sciences in 1910, Mr Seelbach joined Forest City Foundries Co., Cleveland, eventually becoming secretary-treasurer of that firm and vice-president at the time of his resignation in 1946 to head his own company, Superior Foundry, Inc., Cleveland.

In addition to the honors accorded him by the American Foundrymen's Society and the Gray Iron Founders' Society, Mr. Seelbach has been president of the Associated Industries of Cleveland, chairman of the Foundry Educational Foundation's Case Institute Advisory Committee, and chairman of the Sub-Committee on Gray Iron, Foundry Committee, Munitions Board, National Military Establishment.

I. R. Wagner

National Vice-President Elect I. R. Wagner has been active in A.F.S. affairs for many years, serving as a National Director and as chairman and director of the Central Indiana Chapter. He has also been vice-president and president of the National Foundry As-

NEW OFFICERS AT CONVENTION

VICE-PRESIDENT
I. R. WAGNER
Electric Steel Castings Co.
Indianapolis, Ind.

DIRECTOR
DR. JAMES T. MacKENZIE
American Cast Iron Pipe Co.
Birmingham, Ala.

sociation, serving two years in each capacity (1944-48).

A native of Pennsylvania, Mr. Wagner first entered the foundry industry as a member of the maintenance crew of the Alan Wood Iron & Steel Co., Ivy Rock., Pa., in 1912, becoming a routine chemist in its metallurgical laboratory. Joining Midvale Steel & Ordnance Corp. in 1916 as a chemist, he was placed in charge of that firm's Wilmington, Del., branch plant's chemical laboratory, and in 1918 was employed as a metallurgical chemist by the Ordnance Department. In May, 1920, Mr. Wagner became associated with Electric Steel Castings Co., Indianapolis, as metallurgical chemist, becoming general manager and vice-president in 1934 and president of the company in 1942. He retired from the presidency of Electric Steel Castings Co. in November of last year, but remains a director of that firm and of Fletcher Trust Co., Indianapolis.

Harry W. Dietert

Director-Elect Harry W. Dietert is well known to members of A.F.S. for his work in developing sand control methods and in 1940 was awarded the Wm. H. McFadden Gold Medal by the Society for his outstanding achievements in this field. He has been for many years an active member of the A.F.S. Sand Division, is a member of its Executive Committee and several other committees and chairman of its Core Strengths Subcommittee.

A native of Texas and a graduate of Iowa State College, Mr. Dietert served successively on the staff of Westinghouse Electric Co.'s Philadelphia Works, as shop instructor at Rice Institute and as a graduate student at the University of Illinois. Following this, he joined U. S. Radiator Corp. as plant engineer, becoming chief research engineer in 1926 and chief engineer in 1932. He left U. S. Radiator in 1938 to become consulting engineer and in 1940 formed the Harry W. Dietert Co., Detroit, of which he is president.

Albert L. Hunt

Director-Elect Albert L. Hunt has for several years been active in the St. Louis District Chapter of A.F.S., serving on its Board of Directors, as vice-chairman (1947-48) and as its chairman in 1948, when the 53rd A.F.S. Foundry Congress was held in that city.

Born in St. Louis, Mr. Hunt attended grade and high school and Washington University in that city. He began his career as a draftsman for the Mississippi Valley Structural Steel Co., St. Louis, in 1928 and held positions in the same capacity with St. Louis Frog & Switch Co. and the City of St. Louis prior to joining American Brake Shoe Co.'s National Bearing Division, St. Louis, in 1936. He has since been, successively, machine shop superintendent, sales engineer, plant superintendent and is today works manager at Brake Shoe's National Bearing Division.

Dr. James T. MacKenzie

Director-Elect James T. MacKenzie has had a long and distinguished record of service to the Society since first joining it in 1921. An A.F.S. Whiting Gold Medalist (1938), Dr. MacKenzie is past chairman

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National Malleable & Steel Castings Co.
Cleveland, Ohio

(1936-37) of the A.F.S. Gray Iron Division, has twice been selected to deliver the A.F.S. Exchange Paper to the Institute of British Foundrymen, in 1927 and 1938, and presented the Charles Edgar Hoyt Annual Lecture at the 1947 A.F.S. Convention. He has been instrumental in the formation and activities of the Birmingham District Chapter, of which he is past chairman. He is a member of the Gray Iron Division's Advisory Group and represents A.F.S. on a number of joint committees and on the Ferrous Metals Committee, National Bureau of Standards.

A native of Florida, Dr. MacKenzie received a B.C.E., M.A. and, in 1930, an honorary D. Sc. from the University of the South, Sewanee, Tenn., and is today a member of the Board of Trustees of that University. Dr. MacKenzie began his career as an analyst with American Cast Iron Pipe Co. Birmingham, Ala., his present employer, in 1912, becoming successively research chemist, chief chemist and metallurgist, chief metallurgist, and, since 1940, technical director. He is active in a dozen technical societies and a frequent speaker and prolific writer on ferrous metallurgy.

A. M. Ondreyco

Director-Elect A. M. Ondreyco has been active in the formation and work of the A.F.S. Northern California Chapter, serving as its president in 1947 and 1948, and before moving to California, as president of the Pittsburgh Foundrymen's Association in 1934 and 1935.

Mr. Ondreyco began his foundry career as a molder's apprentice prior to World War I, and later served with the Army in France. Upon discharge from the Army, he studied practical chemistry evenings at the Carnegie Institute of Technology, and completed a special foundry apprenticeship at Westinghouse Air Brake Co., Wilmerding, Pa. After nine years as operating metallurgist for Westinghouse Air Brake, Mr. Ondreyco joined Meehanite Metal Corp., serving as foundry engineer and metallurgist for five years, 20 months of which were spent in Meehanite foundries in Australia. Returning to the United States, he became assistant foundry superintendent at Cooper-Bessemer Corp., Grove City, Pa., leaving there to assume his present position as plant manager for Vulcan Foundry Co., Oakland, Calif.

Martin J. O'Brien, Jr.

Director-Elect Martin J. O'Brien, Jr., has just completed filling the unexpired term of the late A.F.S. National Director Alfred M. Fulton. In addition, Mr. O'Brien has been active in affairs of the A.F.S. Western New York Chapter, serving as chapter vice-chairman, chairman and director.

A native of St. Louis, Mr. O'Brien attended high school in that city and completed mechanical engineering courses through the International Correspondence Schools prior to joining American Steel Foundries, East St. Louis, Ill., as a laboratory assistant. He later became an apprentice at that company's Granite City, Ill., plant, resigning to become a special apprentice at Symington-Gould Corp., Depew, N.Y., and successively, assistant foreman, assistant superintendent, superintendent, and, in 1949, works manager.

Walton L. Woody

A.F.S. National President Walton L. Woody, National Malleable & Steel Castings Co., Cleveland, in accordance with A.F.S. by-laws will serve a one-year term as a National Director of A.F.S. upon completion of his term as President in July.

Mr. Woody's record of service to the foundry industry and to the American Foundrymen's Society has been a distinguished one. He has served A.F.S. as a National Director (1943-45), as National Vice-President (1949-50), and as first chairman of the A.F.S. Northeastern Ohio Chapter.

Holder of a B.S. in Chemical Engineering from Rose Polytechnic Institute, Mr. Woody joined National Malleable & Steel Castings Co., Cleveland, in 1914 as a student laboratory worker and has since spent his entire foundry career with that organization, serving, successively, as chemist, metallurgist, melter, assistant superintendent, manager of the company's Chicago, Cleveland, and Sharon, Pa., plants, and today as vice-president and general manager of the company.

Dr. Heinrich Ries, A.F.S. Sand Division Chairman and Seaman Medalist, Dies

Dr. Heinrich Ries

EMINENT GEOLOGIST Heinrich Ries, 79, longtime chairman of the A.F.S. Sand Division Seaman Gold Medalist and a Past Director of the Society, died in Ithaca, N. Y., April 11. Dr. Ries' death took place on the eve of a ceremony scheduled for April 13, when the A.F.S. Central New York Chapter planned to honor him with a plaque commemorating his work on behalf of the foundry industry and the Society in the field of sand research. Born in Brooklyn in 1871, Dr. Ries received his bachelor's, master's and doctor's degrees from the Columbia University School of Mines and from 1898 until his retirement in 1939 taught geology at Cornell University, heading that department from 1914 to 1937.

Active in foundry sand research since 1906, when he presented his first A.F.S. Convention paper, he had been technical director or chairman of the A.F.S. Sand Division or its predecessors since 1921.

Dr. Ries' services to the society and the foundry industry were first recognized with presentation of an Honorary Life Membership in 1923. In 1934 he was named a National Director of the Society, and in 1936 received the A.F.S. Joseph S. Seaman Gold Medal "for outstanding service in foundry sand research."

Dr. Ries' eminence in geological fields brought him many honors from other technical societies, including presidency of the American Ceramic Society and of the Geologic Society of America, and a fellowship in the English Ceramic Society.

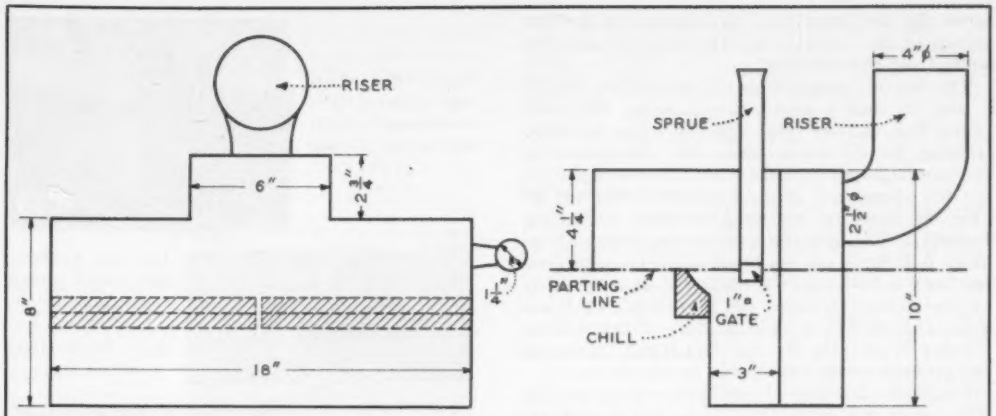


Fig. 1—The test casting was designed to closely approximate previous casting conditions. The flange shown served no purpose in the investigation, but was a part of the original casting.

WATCH YOUR CAST IRON CHILLS!

F. E. Sutherland
Dominion Engineering Works Ltd.
Montreal, Que., Canada

SEVERE GASSING in certain castings made in the summer of 1949 was believed due to constant use of the same set of cast iron chills. The defects were usually found on the surface of the casting remote from the chills, but occasionally the gas was trapped within the metal at varying distances from the source. When the old chills were replaced with new, the condition disappeared completely.

Published information on this subject was very meager. The only reference found merely intimated that chills should not be used more than three times if they were to be subjected to severe conditions. To augment the information at hand, it was decided to conduct an investigation under controlled conditions.

The investigation developed along two lines. The first phase was to observe the progressive formation of the gas by pouring a series of castings using the same set of chills. The second phase was to subject the chills to a critical physical and chemical examination in an attempt to determine the cause and nature of the gas.

For the first phase of the investigation, a casting was designed (Fig. 1) which emulated as closely as possible our previous casting conditions. Two sets of new chills were selected for the tests (set No. 1—9x2¼x2¼ in; set No. 2—8¾x2⅛x2⅛ in.).

The trial castings were made of cupola-melted iron (C, 3.10 per cent; Si, 1.85; Mn, 0.80; S, 0.15; P, 0.25) in dry sand molds. A blacking suspension was painted on the green mold and chills and after drying the hot mold was given a second coat. The castings were gated through the end and risered by means of a side riser as shown. Nine castings were made from chill set No. 1 and were numbered 1, 2, 3, ... 6, then 7x, 8x, 9x. Six castings were made from chill set No 2 and were numbered 1-1, 1-2, 1-3, ... 1-6.

The castings were fractured by means of a ball

NOTE: This paper is one of the prize winners in the 1950 Annual Technical Paper Contest sponsored by the A.F.S. Eastern Canada Chapter.

Fig. 2 (No. 1)—First test casting (chill No. 1) shows dense metal, fine grain, no evidence of gas.

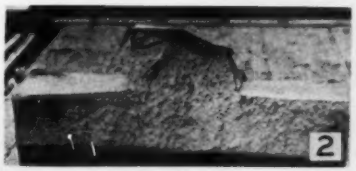


Fig. 3 (No. 2)—The test casting obtained with the second use of chill No. 1 also had fine grain and dense metal, with no evidence of gas.

Fig. 4 (No. 3)— The third casting had a somewhat coarse grain, with a first tendency toward gas.

across the junction of the two arms at the heaviest section of the casting. The fractures were then examined and photographed.

The first two castings from each set of chills (Fig. 2, 3, and 13) show a sound, dense casting. The third casting from each set (Figs. 4 and 14) shows the initial tendency for the gas to form. The photograph for the fourth casting from the second set was destroyed, but the photograph of the fourth from the first set (Fig. 5) shows an increasing tendency toward gas formation. The fifth and sixth casting from each set (Figs. 6, 7, 8, 15, and 16) reveal similiar results. Casting No. 6 in both cases was the first to show the defect on the surface. However, the fracture of No. 6 was good, with no signs of gas in the heavy section. Casting number 7x from the first set (Figs. 9 and 10) showed the gas both on the surface and in the fracture.

Casting No. 8x (Fig. 11) was perfect in all respects. The answer may be that the casting was poured very cold. This theory will be further discussed in the second part of the investigation. Casting No. 9x (Fig. 12) clearly shows the tremendous volumes of gas being generated at this stage. Figure 12 shows the casting as shaken from the mold. This casting blew about 30 sec after pouring was completed with such force that much metal was blown up through the riser.

The series of photographs clearly show the progressive increase in gassing and leave little doubt as to the general effects of repeatedly using the same set of chills.

The location of the defects appears to be a function of the pouring temperature. Unfortunately, temperatures were not considered in this investigation. Optical temperatures were recorded for the castings which prompted this investigation, and on the hot pours it was noted that the blows were so far from the chills that they were not even considered as a source. Castings poured at low temperatures had blows close to the chills and revealed them as the source of the gas.

For the purpose of the second phase of the investigation—the critical examination of the used chills—a new chill was selected and all tests carried out on the used chills were similarly applied to the new chill. This afforded a means of control or comparison.

The first step was to fracture the three chills and note the physical changes that had occurred. Figure 17 shows the fracture of the three chills. From left to right are the new chill, the chill used six times, and the chill used nine times. Certain changes in the metal may be noticed in the two used chills. In the fracture area the changes are evident by the dark discoloration and in the sawed area by a light discoloration. Only the three surfaces within the fractured area are in contact with the molten metal, but the discoloration is evident on all sides.

Figures 18, 19, and 20 show the same three chills after 20 min etching in 50 per cent hydrochloric acid. The deterioration of the outer surface of the iron is even more evident here. Actually the worst effects are evident in the areas not in contact with the molten iron.

An attempt was then made to determine the chemical nature of these deteriorated areas by taking samples from the top surface of each chill with a shaper. Samples were taken progressively deeper and analyzed

Fig. 6 (No. 5)— Gas is confined to fracture, and holes are deeper than in casting of Fig. 5. Much spongy metal.

Fig. 5 (No. 4) First indication of gas holes in the metal.

Fig. 7 (No. 6)—This casting was the first to show gas defects on the surface (see Fig. 19).

Fig. 8 (No. 6)—Fracture shows sound metal in heavy section. Defect is evident on casting surface only.

Fig. 9 (No. 7x)— Extent of gas blow on surface is shown after chipping.

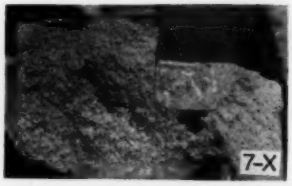


Fig 10 (No. 7x)— Fracture shows deep gas holes in center of casting.

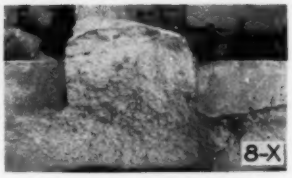


Fig 11 (No. 8x)— This casting was sound in all respects, probably because it was poured cold.

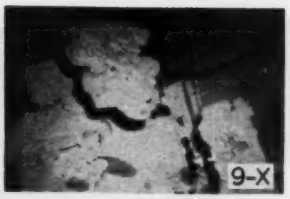


Fig. 12 (No. 9x)—Casting as shaken from the mold shows severe gassing. Metal was blown through riser 30 sec after pouring.

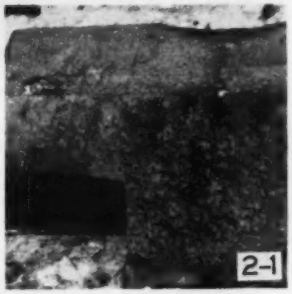


Fig. 13 (No. 2-1)—This casting was sound in all respects. The second casting in this series (No. 2-2) was also sound, showing no sign of gas.

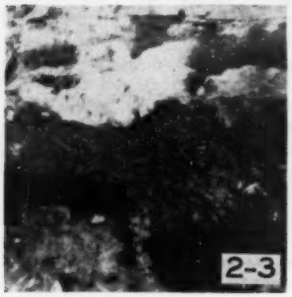


Fig. 14 (No. 2-3)—Casting No. 3 of this series showed the first sign of gas in the fracture only. Much spongy metal was evident.

separately. The metal shavings were like sand when taken from the used chills. The "body" of the metal appeared to have been burned out. This made sampling difficult and results appear to be somewhat erratic. Successive samples were also taken on the new chill to show what accuracy may be expected in the analyses. Samples taken from the center of each chill served as a control. The results of these analyses are shown in Table 1.

An examination of the table reveals some interesting as well as some unexplainable facts. Considering the carbon first, it was noted that the surface of the chill was decarburized to a depth of ⅛ in. At this point the carbon increased far beyond what would be expected as a normal carbon for a common iron.

TABLE 1—CHEMICAL ANALYSIS OF CHILLS

Sample Depth, in.	Total Depth, in.	Composition, % C	Mn	P	S	Si
Unused Chill						
⅛	⅛	3.32	0.70	0.391	0.180	2.08
⅛	¼	3.39	0.74	0.415	0.157	2.09
⅛	⅜	3.35	0.75	0.373	0.144	2.09
Center		3.17	0.71	0.359	0.157	2.11
Chill No. 1—used 9 times						
1/16	1/16	1.34	0.51	0.368	0.292	2.32
1/16	⅛	2.90	0.47	0.387	0.230	2.34
1/16	3/16	3.62	0.47	0.410	0.183	2.47
1/16	¼	3.64	0.47	0.396	0.166	2.38
1/16	5/16	3.78	0.48	0.442	0.166	2.38
1/16	⅜	3.82	0.52	0.460	0.154	2.27
1/16	7/16	3.93	0.52	0.419*	0.146	2.29
Center		3.65†	0.65	0.447	0.117	2.28
Chill No. 2—used 6 times						
⅛	⅛	2.60	0.54	0.400	0.278	2.31
⅛	¼	3.92	0.55	0.497*	0.157	2.33
1/16	5/16	3.82	0.61	0.415	0.152	2.36
⅛	3/16	3.63	0.59	0.429	0.152	2.37
⅛	5/16	3.69	0.61	0.424	0.123	2.35
Center		3.23	0.71	0.488	0.129	2.29

* Erratic phosphorus.
† Carbon checked.

This increase was constant with respect to chill No. 1, while very erratic in chill No. 2. The carbon for the center core of chill No. 1 is higher than that of any common iron cast in this foundry (an attempt will be made to explain this high carbon in a later section).

Little change took place in manganese and silicon and they do not bear any further consideration. Phosphorus showed a tendency to decrease in value from the center out. The results are somewhat erratic, but it is believed that the trend is evident. Sulphur tended to increase from the center out. The writer is unable to offer any explanation, however weak, to satisfy these two phenomena.

Final step in the examination of the used chills was a metallographic examination. Samples were cut from an exposed face of each chill. The samples were about ¼ in. wide and ½ in. long and polished along a face perpendicular to a surface of the chill which had been in contact with molten metal. The samples were polished and photographed at X100, then etched and photographed at X100. These photographs are shown in Fig. 21 for the unused chill, Fig. 22 for chill No. 2, and Fig. 23 for chill No. 1. The photographs were taken at the extreme outside edge of each sample.

An examination of these photomicrographs reveals certain metallurgical changes in the metal, but it is not believed that these changes are in any way responsible for the formation of the gas. What is important, however, is the physical changes in the metal.

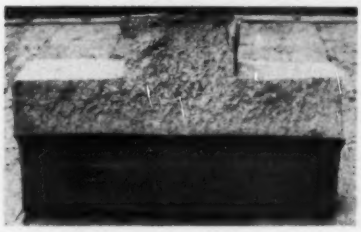


Fig. 15 (No. 2-5)—Left, gassing in this casting was confined to the fracture, which showed deep holes.

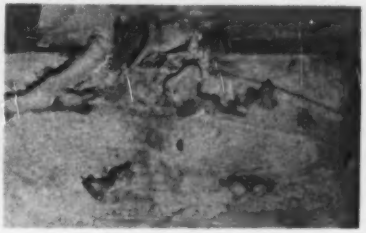


Fig. 16 (No. 2-6)—Right, surface defects are shown after chipping. The fracture also showed gas holes.

Figure 22 (chill No. 2) shows many large voids in the metal. The black area is definitely not carbon. These voids form channels and in this case extended almost to the limit of the sample. The etched specimen reveals these voids somewhat more clearly.

Figure 23 (chill No. 1) shows these voids on a much larger scale. In this case the channels extended to the end of the sample, and it is reasonable to assume that they continued for a considerable distance inward. The formation of massive carbides has occurred in Fig. 23. In Fig. 22, this is just starting.

It is well to summarize the information presented before proceeding to the theories on the production of the gas:

1. The fracture of the chills shows that the molten iron has discolored the chills for varying depths on all sides.

2. Etching of the chills brings out more clearly the area of chill deterioration.

3. Analyses of the samples show (a) that the surfaces of the chills were decarburized to a depth of ⅛ in., and from that point on the carbon content increased; (b) that the manganese and silicon remained constant; and (c) that the sulphur increased from the center out and the phosphorus decreased from the center out.

4. Metallographic examinations reveal large voids in the metal and channelling well into the interior of the chill.

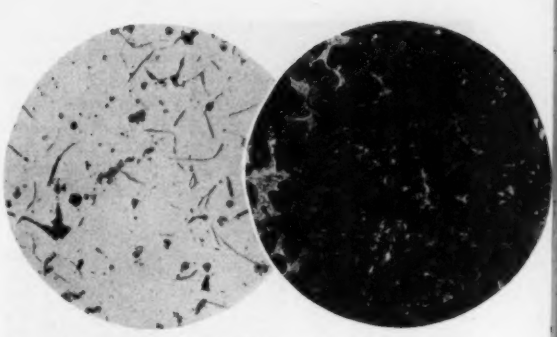
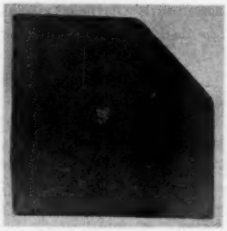
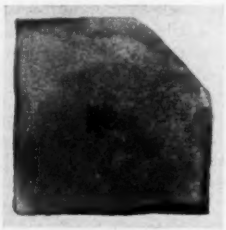


Fig. 21—Metallographic samples taken from extreme outside edge of unused chill. Polished specimen is shown at left, and etched specimen at right. X100





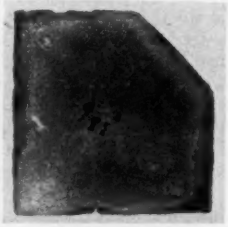


Fig. 18 (above) Etched specimen of unused chill. Fig. 19 (above, right)—Etched chill No. 2 (used 6 times) shows metal deterioration. Fig. 20 (right) —Increased metal deterioration is shown in chill No. 1 (used 9 times).

In developing a theory consider first the heating and cooling cycle which occurred each time the chills were used. When used for the first time, the hot chill (castings were shaken out below red heat) is exposed to the air and at this temperature the iron is easily oxidized. While this is mostly a surface rust at this stage, small cracks develop in the chill and the surface areas of these cracks are also oxidized. Mold atmosphere resulting from various washes and binders was not considered but is sufficiently interesting to warrant study with respect to chill oxidation. This oxidation may occur as $2\ Fe + O_2 \rightarrow 2\ FeO$.

When the chills are used the next time the extreme temperature causes the free carbon in the iron to reduce the iron oxide to iron with the liberation of carbon dioxide. This may be represented as $2\ FeO + C \rightarrow CO_2 + 2\ Fe$. The oxidation-reduction reactions are undoubtedly more complex than illustrated with carbon monoxide, carbon dioxide, or both being involved.

The graphite passing off as carbon dioxide will leave a void in the metal which will increase the surface area exposed to further oxidation during the following cycle. Thus the volume of carbon dioxide released by the reduction of the iron oxide will increase each time the chill is used—all other conditions being equal.

One of these conditions would be temperature. If the pouring temperature is low, the catalytic action

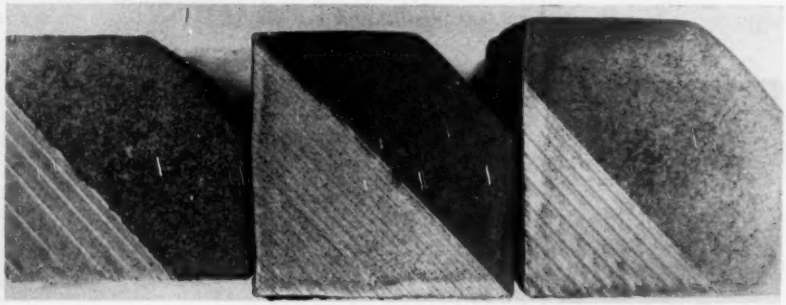


Fig. 17—Three chills were fractured to show discoloration of metal. Left to right—new chill; chill No. 2 (used 6 times); chill No. 1 (used 9 times.) Sawed areas of used chills show light discoloration, and fractures show dark discoloration.

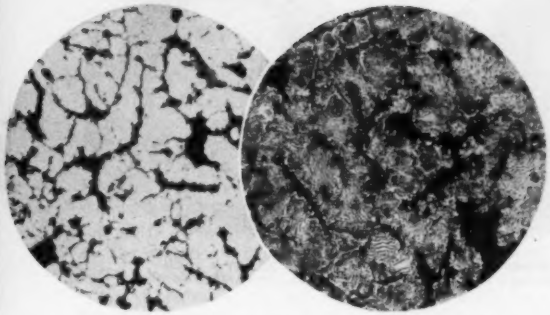


Fig. 22—Many large voids and a considerable amount of channelling are shown in polished (left) and etched (right) specimens of chill No. 2 (used 6 times). X100.

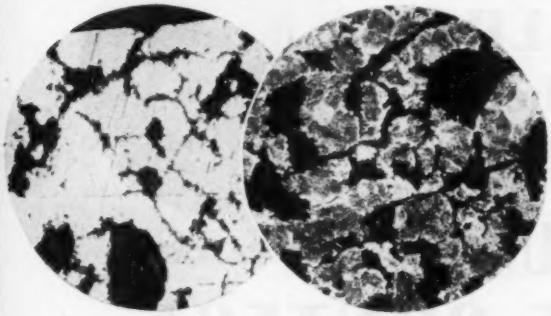


Fig. 23—Voids and channelling are shown greatly increased in the polished (left) and etched (right) specimens of chill No. 1, which was used 9 times. X100.

of the heat may be greatly reduced and the reduction of the oxide would be arrested. Small quantities of gas that may be generated slowly probably would escape through the sand. This condition may explain in part the reason why casting number 8x (Fig. 11) showed no evidence of gas.

It is also believed that the carbon in the blacking wash plays a considerable part in the deterioration of the chills. The chills had a blacking wash each time they were used, the wash penetrating the voids in the metal. The carbon in the wash would then supplement the graphite in the iron in producing the gas and at the same time would tend to accumulate in the voids. The carbon values shown in Table 1 seem to bear out this observation.

Following this line of thought it would appear that the voids in chill No. 1 extended much deeper than first believed. Only in this way can the high carbon (3.65 per cent) at the center of the chill be reconciled. This is borne out by Table 1, indicating that the penetration was not as deep in chill No. 2 as it was in chill No. 1.

If either the iron oxide or the free carbon could be eliminated the formation of the gas would be impossible; or if one could be materially reduced the life of the chill could be greatly increased.

The elimination of the oxide is impossible since shot-blasting cleans the surface only. Eliminating the free carbon is only slightly less difficult. The graphite wash on the chills could be replaced with a silica wash. This would be an effective method of eliminating a large source of free carbon although it might be inconvenient. A reduction of the free carbon in the metal would result in an iron whose heat resistant qualities would be greatly impaired. However, an iron containing about 1.7 per cent free carbon and a medium silicon may produce a metal that would afford a considerable increase in chill life.

Steel chills might be used. Little information seems to be available on the use of steel chills for the purpose in mind. Considering the knowledge acquired concerning cast iron chills, it would be reasonable to expect a much longer effective life from steel chills. Questions such as warpage, higher initial cost, etc., would have to be considered, but the possible use of steel chills should not be ignored.

Briefly, the conclusions that may be drawn from this investigation are:

1. The constant use of the same set of cast iron chills under standard casting conditions will result in gas blows throughout the casting.
2. To insure gas-free castings a set of chills should not be used more than three times.
3. The gas is created by the reduction of iron oxide by means of carbon.
4. The possibilities of using graphite-free washes, low free-carbon irons, and steel chills should not be overlooked.

Acknowledgment

The writer wishes to acknowledge the assistance and advice received from G. E. Tait; J. G. Hunt; F. Clark; and H. Lawson for certain photographs; and J. Wilcock for the metallographics.

A.F.S. Gold Medalist Thomas Turner, Pioneer Ferrous Metallurgist, Dies

Thomas Turner

A.F.S. Gold Medalist Thomas Turner, 90, credited by many in the ferrous metals industries with having founded the science of cast iron metallurgy, died in his native England in January. Honored by the American Foundrymen's Society in 1926 with the Seaman Gold Medal for outstanding contributions to the foundry industry, he was world-renowned for his classic experiments on the influence of silicon on cast iron and for his work with non-ferrous metals. For many years head of the Department of Metallurgy at Birmingham University, Birmingham, England, Professor Turner retired from active university work in 1926. During his lifetime, Professor Turner was signally honored by foundry and metals organizations throughout the world.

HAROLD M. CARTY
1st, GRAY IRON MOLDING

JOHN G. POLINO
1st, STEEL MOLDING

HILARY J. HECK
1st, NON-FERROUS MOLDING

MARVIN L. LOHNES
1st, METAL PATTERNMAKING

ANNOUNCE WINNERS of the 28TH ANNUAL APPRENTICE CONTEST

CHARLES J. HOFSCHROER
1st, WOOD PATTERNMAKING

FIFTEEN FOUNDRY APPRENTICES, twelve from the United States and three from Canada, won top honors over a field of 276 entries in the 28th Annual A.F.S. Apprentice Contest, judged March 31 at the New York State Institute of Applied Arts and Sciences, Buffalo. The winning apprentices were awarded first, second and third places in each of five contest divisions—Gray Iron Molding, Steel Molding, Non-Ferrous Molding, Wood Patternmaking and Metal Patternmaking. Represented in this year's Contest were 76 plants and eight A.F.S. Chapters, each of which held local contests to determine entries for the National Judging.

For the first time since World War II, veterans and non-veterans shared top honors about equally. The diminishing number of veteran contestants is due to eligibility rules of the Contest, which stipulate that the Contest is open to all apprentices in the United States Canada and Mexico taking a regular course of training of not less than three years' duration, who are not over 24 years old on the day they prepare their entries, or if they are veterans, are allowed an age limit of 24 plus length of services in the Armed Forces.

First prize winners in their respective Contest divisions are: *Gray Iron Molding*, Harold M. Carty, Caterpillar Tractor Co., Peoria, Ill.: *Steel Molding*, John G. Polino, Dominion Engineering Works, Ltd., Lachine, Que., Canada: *Non-Ferrous Molding*, Hilary J. Heck, Nordberg Mfg. Co., Milwaukee: *Metal Patternmaking*, Marvin L. Lohnes, Caterpillar Tractor Co., Peoria, Ill.: and *Wood Patternmaking*, Charles J. Hofschroer, Kay-Brunner Steel Products, Inc., Alhambra, Calif.

These five divisional contest winners were guests of A.F.S. at its 55th Foundry Congress in Buffalo, April 23-26, when they each received $100 prizes and certificates from A.F.S. National President Walton L. Woody at the Society's Annual Business Meeting.

Second prize winners in each of the five divisions who received $50 prizes at appropriate plant or chapter ceremonies are:

Gray Iron Molding, Gerald Schrank, Nordberg Mfg. Co., Milwaukee; *Steel Molding*, Adolph C. Zinn, Waukesha Foundry Co., Waukesha, Wis.: *Non-Ferrous Molding*, Gilbert Dandoy, Montreal Bronze, Ltd., Montreal, Que., Canada: *Metal Patternmaking*, Joseph E. Collins, Packard Motor Car Co., Detroit; and *Wood Patternmaking*, Eugene A. Busch, Worthington Pump & Machinery Corp., Buffalo.

Winners of $25 third prizes are: *Gray Iron Molding*, Donald N. Marinelli, Fulton Foundry & Machine Co., Cleveland: *Steel Molding*, Norman G. Bublitz, Bucyrus-Erie Co., South Milwaukee, Wis.: *Non-Ferrous Molding*, T. Grant Wilcox, Dominion Engineering Works, Ltd., Lachine, Que., Canada: *Metal Pattern-*

making John W. Burkholder, Jr., Central Pattern Co., St. Louis: *Wood Patternmaking*, Allen R. Klein, Olney Foundry Div., Link-Belt Co., Philadelphia.

Harold M. Carty, 23, who took first prize in Gray Iron Molding, is in his second year of a four-year apprentice course at Caterpillar Tractor Co., Peoria, Ill. Graduating from high school in 1945, he went directly into the Navy and served 20 months as a hospital corpsman. Upon discharge in 1947, Carty tried his hand as a machine operator at Caterpillar, left there to become a truck driver, then returned to Caterpillar to begin his apprenticeship in 1949. He is married and has a daughter one-year old.

Gerald Schrank, second-prize winner in Gray Iron Molding, began his molder apprenticeship at Nordberg Mfg. Co., Milwaukee, in 1948. A Milwaukeean, Schrank left high school to serve for a brief period in the Navy, returning to complete a course in trade instruction at West Allis Vocational School. Since 1943, he was first a shoe clerk and then a helper at International Harvester Co. where he watched foundrymen at work. Schrank decided to make the foundry his life's work, and was accepted as an apprentice by Nordberg in 1948.

Third-place winner in Gray Iron Molding is Donald N. Marinelli, molder apprentice at Fulton Foundry & Machine Co., Cleveland. A native of Cleveland, Marinelli attended high school there, excelling in athletics. Marinelli, who is 21, began as an employee of Fulton Foundry's pattern shop in 1946, leaving in 1948 to serve in the Marines for a year. Upon discharge he rejoined Fulton Foundry as a molding apprentice in December, 1949.

John G. Polino, 22, first-prize winner in Steel Molding, is now in his fourth year of apprenticeship at Dominion Engineering Works, Ltd., Lachine, Que., Canada. A native of Lachine, Polino attended high school there and upon graduation went to work in a local industrial plant as a machine operator. In spite of earning high wages as an operator, Polino wanted to make the foundry his life's work and applied for an apprenticeship at Dominion Engineering in 1947.

Adolph C. Zinn, Steel Molding second-place winner, is now in his third year as a foundry apprentice at Waukesha Foundry Co., Waukesha, Wis. A native of Milwaukee, Zinn, 25, attended high school and the University of Wisconsin Extension Division there for a year. After two years in the Army, Zinn joined J. C. Penney Co., variety store chain, as a trainee in 1947, but left there the following year to become an apprentice at Waukesha Foundry.

Third-prize winner in Steel Molding Norman G. Bublitz has been a molder apprentice at Bucyrus-Erie Co., South Milwaukee, Wis., since 1947. Twenty-one years old, he is a native of Cudahy, Wis., and attended high school in South Milwaukee, joining Bucyrus-Erie immediately after graduation.

Hilary J. Heck, who took first prize in Non-Ferrous Molding, is completing his third year of apprenticeship at Nordberg Mfg. Co., Milwaukee. Born March 22, 1928, in Rubicon, Wis., Heck attended the St. John's School for the Deaf and the St. Mary School for the Deaf, Buffalo, N. Y., graduating in 1948. After completing a related course in trade instruction at Milwaukee Vocational School, Heck began his molder apprenticeship at Nordberg in the fall of 1948. He is

SECOND PLACE WINNERS

JOSEPH E. COLLINS
2nd, METAL PATTERNMAKING

EUGENE A. BUSCH
2nd, WOOD PATTERNMAKING

GERALD SCHRANK
2nd, GRAY IRON MOLDING

ADOLPH C. ZINN
2nd, STEEL MOLDING

GILBERT DANDOY
2nd, NON-FERROUS MOLDING

the descendant of a long line of foundrymen and has several close relatives employed in Nordberg's foundry.

Gilbert Dandoy, winner of second place in Non-Ferrous Molding, is a fourth-year apprentice at Montreal Bronze, Ltd., Montreal, Que., Canada. Born December 31, 1929, in Belgium, Dandoy came to Canada at an early age and attended Montreal High School. In his own words, "I was always interested in shaping objects in sand and that's why I chose the molding trade." Interested in hockey, baseball and boxing, Dandoy is a former member of Montreal's Golden Gloves team. He is a member of A.F.S.

T. Grant Wilcox, who took third prize in Non-Ferrous Molding this year, is the second apprentice from Dominion Engineering Works, Ltd., Montreal, to place in this year's contest. Wilcox was born in 1930 at Edmonton, Alberta, Canada, and graduated from high school in 1949. He joined Dominion Engineering Works, Ltd., as an apprentice that year.

Metal Patternmaking first-prize winner Marvin L. Lohnes is completing a four-year patternmaking apprenticeship at Caterpillar Tractor Co., Peoria, Ill. Lohnes, 27, served as an Army combat engineer from 1943 to 1946. He first joined Caterpillar as a hand trucker in 1946 and the following year joined the company's apprentice program. Since winning the award, he has become a metal pattern worker in Caterpillar's foundry.

Joseph E. Collins, Jr., who placed second in Metal Patternmaking, is an apprentice patternmaker at Packard Motor Car Co. in his native Detroit. Twenty-two years old, Collins graduated from high school in Detroit and attended Lawrence Institute of Technology for a year before becoming an apprentice at Packard in 1946. He is a member of A.F.S. and SAE.

John W. Burkholder, Jr., third-place winner in Metal Patternmaking, is completing his fourth year as an apprentice metal patternmaker at Central Foundry Co., St. Louis. Burkholder is no stranger to national apprentice contest honors, having won first prize in wood patternmaking in 1949 and the following year was the first apprentice to win the Metal Patternmaking contest, new in 1950. Upon discharge from the Navy in 1946, Burkholder came to Central Pattern Co. one day to accompany his father, one of Central's patternmakers, home from work. While there he watched the patternmakers at work, became interested, and applied for an apprenticeship. Told that a metal patternmaking apprenticeship would be open later, he worked on the shellacing bench for a year, then became an apprentice on July 1, 1947.

First-place winner in Wood Patternmaking is Charles J. Hofschroer, who is in his second year as a patternmaker apprentice at Kay-Brunner Steel Products, Inc., Alhambra, Calif. A graduate of Alhambra High School, Hofschroer joined the Coast Guard in 1943, serving for two years. Upon discharge in 1946, he became an apprentice patternmaker at Patterncraft, Burbank, Calif., in 1946, leaving there in 1950 to join Kay-Brunner.

Eugene A. Busch, who took second prize in Wood Patternmaking, completed a five-year patternmaking apprenticeship at Worthington Pump & Machinery Corp., Buffalo, on April 7. Born November 20, 1921, in Buffalo, Busch attended Technical High School there and was a student at the University of Kansas

THIRD PLACE WINNERS

ALLEN R. KLEIN
3rd, WOOD PATTERNMAKING

JOHN W. BURKHOLDER
3rd, METAL PATTERNMAKING

T. GRANT WILCOX
3rd, NON-FERROUS MOLDING

NORMAN G. BUBLITZ
3rd, STEEL MOLDING

DONALD N. MARINELLI
3rd, GRAY IRON MOLDING

when he was called into the Navy to serve four years. He joined Worthington as an apprentice in 1946. Interested in sports, he pitches in a semi-pro baseball league and has a 185 bowling average.

Allen R. Klein, who took third prize in Wood Patternmaking, is in his second year as an apprentice patternmaker at Link-Belt Co.'s Olney Foundry Division, Philadelphia. A native of Philadelphia, Klein, 25, graduated from Murrell-Dobbins Vocational School there in 1944 and joined the Army the following year. He has been an apprentice at Link-Belt since 1949.

Eight A.F.S. Chapters held local apprentice contests in preparation for the National Judging at Buffalo, March 31—Western New York, Eastern Canada, St. Louis District, Northern Illinois-Southern Wisconsin, Detroit, Northeastern Ohio, Wisconsin and Southern California. The latter chapter division participated only in the wood patternmaking division of the National Judging, but later held a contest for molding divisions. A.F.S. Metropolitan Chapter also held a belated local apprentice contest.

Chairmen of the Apprentice Contest Committees of the various participating chapters are: *St. Louis District,* F. W. Burgdorfer, Missouri Pattern Works, St. Louis: *Wisconsin,* Andrew A. Bottoni, Milwaukee Vocational School, Milwaukee; *Northern Illinois-Southern Wisconsin,* Ralph Lightcap, Rupp Pattern Co., Rockford, Ill.; *Western New York,* Otto V. Guenther, New York State Institute of Applied Arts and Sciences, Buffalo; *Detroit,* Robert Spengler, Annex Pattern Works, Detroit, and Willard E. Kidwell, Packard Motor Car Co., Detroit; *Eastern Canada,* W. P. Sullivan, Warden King, Ltd., Montreal, and G. Ewing Tait, Dominion Engineering Works, Ltd., Montreal; *Three Rivers, Que., Canada* (Division of Eastern Canada Chapter contest), Leon Lesage Technical School, Three Rivers; *Southern California,* H. L. Bierley, Production Pattern & Mfg. Co., Los Angeles; and *Northeastern Ohio,* Frank C. Cech and James Goldie, Cleveland Trade School, Cleveland.

A.F.S. Apprentice Contest Committee, which correlates, plans and arranges contests and National Judging each year, is headed by Chairman Roy W. Schroeder, University of Illinois, Navy Pier Branch, Chicago. Committee members are: F. W. Burgdorfer, Missouri Pattern Works, St. Louis; George E. Garvey, City Pattern Foundry, Inc., South Bend, Ind., Vaughan C. Reid, City Pattern Foundry & Machine Co., Detroit; R. L. Selburg, Caterpillar Tractor Co., Peoria, Ill.; E. J. McAfee, Puget Sound Naval Shipyard, Bremerton, Wash.; A. C. Gocher, Fletcher Works, Inc., Philadelphia; J. A. Havnen, Liquid Carbonic, Inc., Chicago; James Holtzapple, Continental Foundry & Machine Co., East Chicago, Ind., and G. Ewing Tait, Dominion Engineering Works, Ltd., Montreal.

Success of the 1951 A.F.S. Apprentice Contest is due in large measure to firms and institutions that have given freely of their time, materials and facilities. They are:

City Pattern Foundry & Machine Co., Detroit (metal castings for Metal Patternmaking Division); City Pattern Foundry Co., Inc., South Bend, Ind. (aluminum patterns for molding divisions); Missouri Pattern Works, St. Louis (finishing of patterns for molding divisions); Caterpillar Tractor Co., Peoria, Ill. (shipping boxes for molding division patterns); New York State Institute of Applied Arts and Sciences, Buffalo (facilities for National Judging); Pratt & Letchworth, Inc., Buffalo (x-ray facilities for inspection of contest castings); and Worthington Pump & Machinery Corp., Buffalo (templates for judging contest patterns for accuracy).

National Judges for the 28th A.F.S. Apprentice Contests were: *Gray Iron Molding,* Joseph M. Clifford, Bison Castings, Inc., Buffalo and Martin W. Pohlman, Pohlman Foundry Co., Inc., Buffalo. *Steel Molding,* Martin J. O'Brien, Jr., Symington-Gould Corp., Depew, N.Y., and Michael Connelly, Pratt & Letchworth, Inc., Buffalo. *Non-Ferrous Molding,* Joseph Nixon, Whitehead Metal Products Co., Inc., Buffalo; Robert Forrest, Lakeside Bronze, Inc. Buffalo; and Joseph Maher, Lumen Bearing Co., Buffalo. *Wood Patternmaking,* Robert Sommerville, Pratt & Letchworth, Inc., Buffalo; and Oscar E. Gortzig, Worthington Pump & Machinery Corp., Buffalo. *Metal Patternmaking,* Richard Wade, Wade & Horrocks, Inc., Buffalo, and I. M. Stohle, Symington-Gould Corp., Depew, N.Y.

Navy's S.W. Brinson Dies

S. W. Brinson

Navy Master Molder Stanley W. Brinson, 60, of Norfolk Naval Shipyard, Norfolk, Va., died of a heart attack at his home in Norfolk on March 20. Mr. Brinson's achievements in developing steel foundry techniques and his activities on behalf of the American Foundrymen's Society over a period of many years were rewarded by A.F.S. with an Honorary Life Membership. A native of Portsmouth, Va., Mr. Brinson began his lifelong association with Norfolk Naval Shipyard as an electrical helper in 1906, leaving there for four years to take a degree in electrical engineering at Virginia Polytechnic Institute. Resuming his association with the Shipyard, Mr. Brinson was named mathematics teacher at the Shipyard's Apprentice School.

He became a foundryman in 1915, when the Shipyard asked him to establish a branch laboratory in its foundry and a year later was appointed assistant to the shop superintendent and placed in charge of gas engines and foundry, accounting, tests and manufacturing production. Mr. Brinson was appointed Master Molder (foundry superintendent) in 1930.

An acknowledged authority on steel foundry and molding practices, Mr. Brinson spoke on those subjects before A.F.S. and other technical society groups throughout the country and wrote many articles for the technical press. At the time of his death, Mr. Brinson was president of the National Association of Mechanics and Foremen.

ZIRCON SAND

properties and uses in

CORES AND FACINGS

Arthur Smith
Secretary
Millmaster Chemical Corp.
New York

ZIRCON SAND can be used in the same manner as ordinary foundry sand. It has been used as green sand, torch-dried sand, oven-dried sand, and air-dried sand, requires no special binders and works well with any good sand or core binder.

Investigation of zircon sand as a core and facing material started in 1936, when a few experiments showed that the material had a remarkable combination of properties and good possibilities for foundry use. Preliminary investigations showed that judicious use of zircon sand could result in substantial savings in cleaning costs and in the production of superior quality steel castings.

Price Now Economically-Justifiable

In 1945, the price of zircon sand dropped sufficiently to permit its use on a commercial scale. The desired grade was available at an economically justifiable cost and zircon sand developed into an important foundry tool. One foundry, which uses 500 tons of sand daily, reports employing up to a ton of zircon sand each day.

On some castings it has been found that the use of zircon sand can save up to five or six times its cost in cleaning and grinding of castings. Examples are the cored bolt holes in heavy sections. Generally, these holes were formerly cleaned by burning and grinding.

Zircon sand green strength can be made sufficient to offset weight of these dipper lip bolt hole cores.

Now they usually need only a bare minimum of grinding and often require no touching-up at all.

Zircon is a silicate mineral ($ZrSiO_4$) of the element zirconium. Often used as a gem stone, only in recent years has it become an important industrial material, its main uses being in the manufacture of ferroalloys, super refractories, ceramics, and chemicals.

As a sand, zircon is fine grained, native to certain shore areas. Richest grades are found in Australia. Some is found in this country, in Florida and California, but its quality is generally inferior to that found in Australia.

Zircon is mined and beneficiated, great care being exercised to insure chemical and petrographic control that will maintain the quality and uniformity required for industrial use. This control is important in foundry sands in order to eliminate the variable of changing grain size and to insure the proper mixing of sand.

Properties of one grade of zircon foundry sand, for example, are: melting point, 4100 F; sintering point, 3800 F; chemical analysis – ZrO_2 – 66 per cent min, SiO_2 – 33.5 per cent max, TiO_2 – 0.30 per cent max, Fe_2O_3 – 0.10 per cent max.

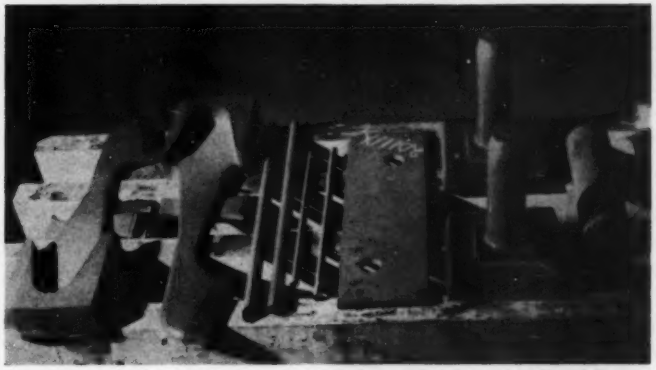
Thermal expansion is less than one-third that of silica sand; heat diffusivity coefficient is 1½ to 2 times that of silica sand; and weight per unit volume is approximately twice that of silica sand.

Screen analysis of this particular zircon sand, which is of A.F.S. Fineness No. 104.6, is:

Sieve	Retained, %
65	0.7
100	14.8
150	61.1
200	23.1
270	0.2
Pan	Trace

Among the properties of zircon sand, high heat diffusivity coefficient is most important to foundrymen. This property is a functional of thermal conductivity, specific heat, density of the mineral, and fineness. A high heat diffusivity coefficient is valuable in two ways. First, it provides a chilling action that can be used to promote directional solidification of metal, producing sounder castings. Second, this same chilling action, in

Examples of typical cores made from zircon sand mixed with iron oxide, core oil, cereal binder, water.



conjunction with a normally low permeability prevents penetration of molten metal into voids in molding sand, thus reducing or eliminating penetration and burnt-on sand. Zircon sands do not always have low permeability—it is possible to produce extruded cores with high permeability in diameters as small as ⅜ in. with them.

Chemical inertness and refractoriness eliminates fusion and related surface defects. Chemical purity is of prime importance for the establishment of standard, uniform mixing cycles and mixes. The low coefficient of thermal expansion permits production of zircon sand cores and molds that are resistant to thermal shock and spalling.

Substitutes for Special Chills

Zircon sand is adaptable to special chilling. Frequently, a foundryman encounters a point in a casting which requires a slight chilling to promote soundness. Zircon sand, applied as a facing at such a location, provides the necessary boost in freezing rate and eliminates need for costly special chills, frequently used only once.

The addition of cereal binders, core oil, bentonite, etc., to zircon sand provides the same insulating layer around each grain of sand as that present in silica sands. Although the film of binders decreases the rate of heat extraction, zircon sand mixes retain sufficient heat-extracting ability to permit use as mild chills in silica sand molds.

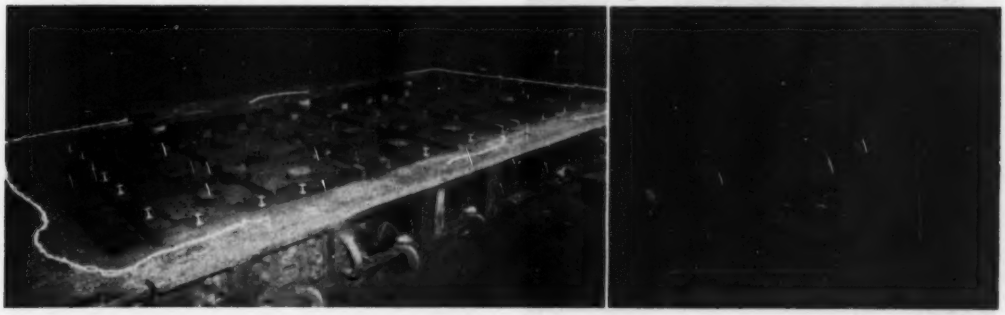
Where heavier chilling is needed, zircon sand can be adapted to the old foundry technique of bedding chills in sand. In this application, zircon sand facing is placed on the pattern to a depth of about ¾ in. (unrammed) at the location requiring the chill. Then one or more chills are bedded in this facing, and the mold is rammed in the usual manner.

The thin layer of sand between the hot metal and the chill retards the chilling action somewhat, but the chill produced is sufficient for all but the most severe applications. At the same time, economies are realized because it is usually unnecessary to make chills to the exact size and shape of the mold. In those few cases where especially-shaped chills are still required, it is unnecessary to make them to mold dimensions and they can sometimes be used on two or more patterns of similar shape. The chills are not damaged by fusion, are easily reclaimed, and can be re-used without reconditioning.

While the initial expense of zircon sand facing is more than that of ordinary sands, savings in cleaning and machining costs return the investment several times over. The amount used on many castings costs about $1. In cases where a half zircon-half silica sand mix can be used, this cost is cut to about $0.60.

Because of its greater cost, it has been found ex-

Left: Cores for this mold were made from zircon sand. Right: The finished 11,000 lb casting.



Mold for insert frog, showing use of zircon sand in flangeways.

Group of track work castings made from mold at left, shown as received in the cleaning room with gates and risers removed and shot-blasted only. Castings require no further work before delivery.

pedient to identify the several types of zircon mixes by means of aniline dyes. Green sand is dyed green, dry sand is red, and half zircon-half-silica sand is left its natural color. This practice aids in controlling the amount used and places a psychological check on workmen who might use the wrong sand instead of the correct mix.

Zircon sand can be employed in all types of mold and core practices, from hand ramming to core blowing. Cores can be extruded in sizes from ⅜ in. to 2½ in. in diameter.

Use Standard Mixers for Zircon Sands

Zircon sand mixes can be prepared in any standard sand mixer. The amount of sand should be limited to that which can be used the next day, provided it is kept damp or remixed. Sand formulas vary with the type of work and from foundry to foundry. Foundries interested in using zircon sand must try different mixes until the right ones are developed for the work and shop involved. This requires a knowledge of silica sand fundamentals. Zircon sand can be substituted for silica sand in a formula, provided these simple rules are followed:

(1) Because of their fineness and rounded grains, zircon sands normally make less permeable mixes than do many silica sands. Gas producers, such as core oils and water, should be kept to a minimum. Additions of binders such as cereal and clay should be kept as low as possible if an open sand is required. Most applications of zircon do not require a high permeability.

ZIRCON CORE AND FACING MIXTURES

Mixture	A	B	C	D	E
Zircon Sand, lb	100	1500	90	250	400
Zircon Flour, lb		300	10		
Silica Flour, lb					36
Fire clay, lb		60			
Western Bentonite, lb					4.5
Corn Flour, lb	1		1/2	3/4	
Iron Oxide, lb				1/2	
Raw Linseed Oil, qt	1				
Core Oil, qt		12	1/2	1	6
Water, %	2 1/2	7-8	3-4	3	6.3-6.6
Green Compression, psi			4	6	7-9
Green Permeability			75-90		6-10
Dry Compression, psi				250-300	12-14
Dry Permeability			140		160-200

Workman shown adding oil to zircon sand in mixer.

(2) Zircon sand has approximately one-half the volume of silica sand per unit of weight. It is thus essential that additions of cereal, oil, water, etc., be made by weight and not by volume when developing zircon sand formulas. After a mix is evolved, additions may be made by volume if desired, for by then the volume of the proper amount of an addition has been determined.

(3) If a zircon core must be handled when green, or when making tall or large cores, it will usually be necessary to increase the green strength over that used in the replaced silica sand. Greater weight of zircon may cause the core to break or sag if this precaution is not observed.

(4) Because of the greater weight of zircon sands, it is necessary to use a mixer in good repair and a slightly longer mixing cycle. Zircon sands do not develop green strength as early as silica sands, but once

the green bond starts to develop, it builds up rapidly. Novices in handling zircon sands should be careful about adding such binders as cereals.

(5) For facing sands, it is good practice to riddle zircon sand onto the pattern until the molder is thoroughly familiar with its use. This aerates the sand and distributes it evenly. After the molder has learned to work with the sand, this practice can be modified.

(6) When using oil sand, be sure the oil is completely oxidized or polymerized. Unbaked core oil is even more dangerous in zircon sand than it is in silica sand because of the usually-lower permeability. Zircon cores may take longer to bake but suitable venting will help keep baking time to a minimum. Phenolic and other resins can easily combat baking troubles. Water and core oil requirements with zircon sands are low compared to those of silica sand. Too much core oil will make a core with poor collapsibility and may crack the casting, or the core may not bake thoroughly.

(7) If it should be necessary to make a mold or core with part zircon sand and part silica sand, and if one of the sands is rammed-up before introducing the other, it is important that the rammed sand be well scored with a trowel before introducing the second sand. This insures good knitting of one sand to the other at the interface. Occasionally it may even be necessary to use nails or wire to secure a good bond.

Acknowledgment

The author is indebted to Taylor-Wharton Iron & Steel Co., High Bridge, N. J. for providing data and photographs used in this article.

FACTORS AFFECTING OIL-SAND CORE BAKING

Harry W. Dietert
President
H. W. Dietert Co.
Detroit

MORE AND MORE EMPHASIS is being placed on standardization of sand test results. One of the most troublesome tests in this regard is the baked tensile strength and hardness of oil-sand cores.

The advisability of baking in a laboratory test oven where conditions may be controlled has been mentioned many times and is generally accepted. The purpose of the following remarks is to bring out some of the variables in baking and how to overcome them.

The exhaust pipe of the oven should extend through the roof of the building at least 5 ft above any adjacent building projection in order to avoid eddy air currents which might interfere with air flow from the exhaust duct system. An atmospheric air hood should also be used in the exhaust duct system just above the core oven. When this is not convenient, it is permissible to mount an exhaust fan on top of the atmospheric air hood.

The core test oven should be equipped with a chromium plated reflector plate mounted just below the baking tray. This reflector plate is easily installed in older style core ovens to obtain uniformity of bake between top and bottom of specimens. The following dry hardness test data for five specimens illustrate the uniformity that should be obtained: No. 1—top and bottom, 69; No. 2—top, 67, bottom, 70; No. 3—top and bottom, 66; No. 4—top and bottom, 68; No. 5—top 66, bottom, 67.

Baking of test cores should not be force dried as is the case when additional heating elements are placed in the bottom of the core test oven. When the core test oven is equipped with top heating elements, which heat the incoming or recirculated air to the selected baking temperature, and with a heat-reflecting surface below the baking zone, a very efficient baking rate is secured.

Uniformity of test results are affected by the time that the green rammed core specimens are allowed to air dry before being placed in the oven. The following test data are illustrative of the effect that air drying prior to baking has on the tensile strengths of test cores: drying times 0.0 hr, ½ hr, and 1 hr resulted in tensile strengths of 205; 182; and 178, respectively.

In research testing it is recommended that the green rammed core specimen be placed in a metal humidor whose wall surface has been moistened. The core specimens are placed in the humidor as they are rammed. The entire set of cores is allowed to stand 15 min in the humidor after the last core is rammed, for equalization. The entire oven load is then removed from the humidor and placed in the oven at once. The beneficial effects of this procedure are illustrated by the average tensile strengths obtained for three trays of cores: No. 1—126.5 psi; No. 2—125.5; No. 3—120.5.

The uniformity of baked strength test data is greatly improved by uniformity in the core mixture itself, care exercised in preparing the core specimens, prevention of unequal air drying of green core specimen prior to baking, and in having the core test oven installed correctly and maintained in good order.

With good practice, the core test oven will produce tensile results for various baking times that are comparable to those in the following tabulation.

Specimen	Tensile Strength, psi				
No.	45 min	60 min	75 min	90 min	105 min
1	105	160	177.5	190	162.5
2	110	160	175	181.5	160
3	110	160	177.5	177.5	167.5
4	105	157.5	175	177.5	155
5	107.5	160	180	177.5	160

Variations between bakes are traceable to variations in the absolute humidity of the incoming air. An absolute humidity of 60 grains per lb of incoming air produced a tensile strength of 278 psi for a certain linseed base core oil and a specific sand. In saturated air the tensile strength dropped to 193.0 psi.

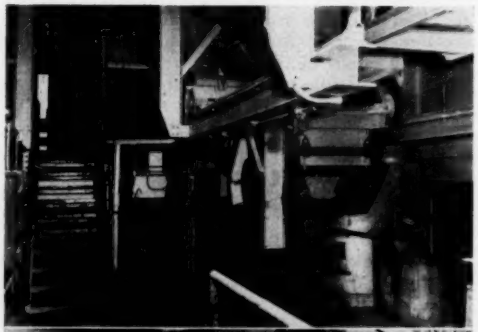
When the absolute humidity was above or below 60 grains per lb of air the tensile strength dropped materially, for example, at 90 or 29 grains of moisture per lb of air, the tensile strength fell to 155 psi.

The A.F.S. Subcommittee on Core Strength is doing considerable work to uncover all of the facts pertaining to the effect of absolute humidity on the strength of baked cores.

MODERN FOUNDRY METHODS

WHY INTERNATIONAL HARVESTER'S MEMPHIS PLANT IS A GOOD PLACE TO WORK

Dried core sand from the two 50-ton storage hoppers is transferred from weigh hopper to muller-type mixer where 1500-lb batches of core sand are prepared. The rotary dryer handles 8 tons of new core sand per hour.



Core mixtures are fed to the hoppers by buckets on a monorail. Coremaking line has three large blowers, two benches with small blowers, and four benches for hand work. Green cores are placed on monorail chain conveyor at the left. Sizes range up to about 120 lb.

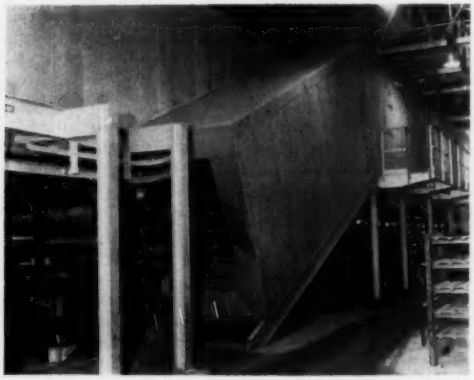
In the horizontal continuous core oven, cores are baked at 475 F for three hours. Note green topped core.

About 500 of the 2200 employees of International Harvester Co.'s $20 million Memphis Works are in the foundry where they enjoy working conditions and modern foundry facilities which make the plant a leader in "The Foundry is a GOOD Place to Work" movement. With a spacious 184,000 sq ft of floor area, the plant is modern brick and glass construction, well ventilated by natural and forced draft, insulated from heat and cold with a special roof, and acoustically insulated to a considerable extent. Floor in most areas is wood block construction.

Forced ventilation provides for 13 changes of air per hour in the molding and pouring areas, 10 changes per hour in the cleaning department, and 8½ changes per hour in the core department. All sources of fume and dust are exhausted as close as possible to the source.

Designed for 120 ton production per shift, the plant operates two shifts per day, melting in 60-in. cupolas run on alternate days. Castings produced go into over 50 types of farm equipment manufactured at Memphis.

Primary units of the Memphis Works foundry are the three molding areas, the sand reconditioning tower, the



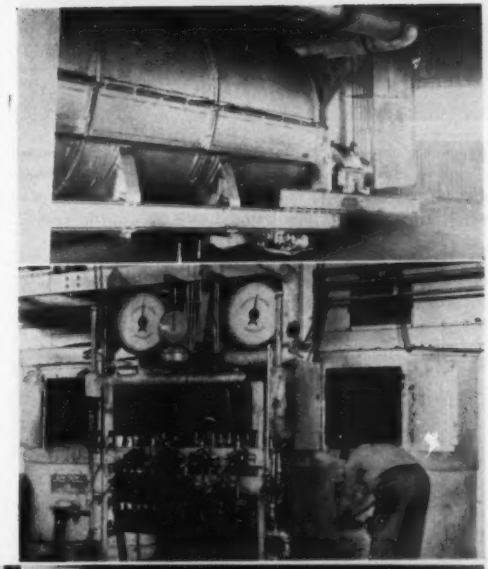
◀ Foundry of International Harvester Co.'s Memphis Works provides ample light and natural ventilation through brick and glass construction, continuous ridge ventilators. six-story sand tower is at extreme left.

▶ Sand tower provides for reclamation, storage, and conditioning of molding sand. Shakeout and spilled sand reaches 6th floor by bucket elevator where it passes over cooling reciprocator before going to 5th floor. The centrally-located tower contains two complete units for reconditioning and storing sand for three molding floors.

MODERN FOUNDRY METHODS

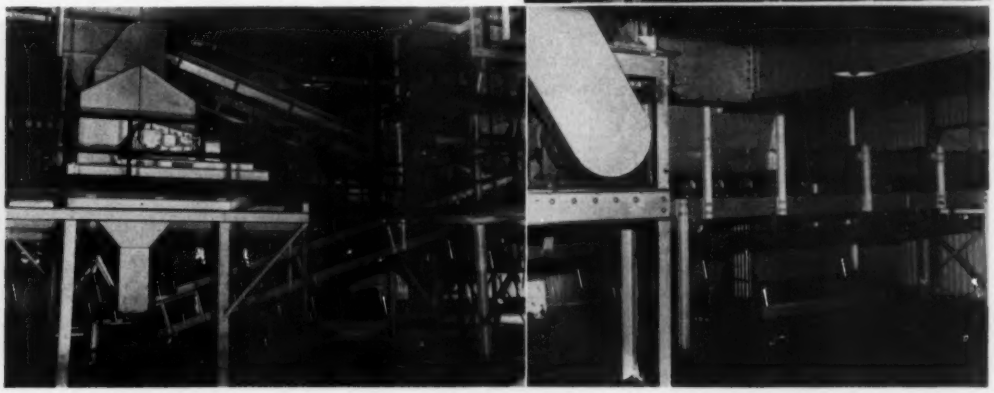
core department, the melting department, the materials storage yard, the cleaning department, and the pattern shop. New sand enters the sand system by way of the core room where approximately 25 lb of cores are produced per 100 lb of castings. The six-floor sand tower provides for cooling, fines removal, storage, and conditioning of molding sand. Sand tests are made every half hour. Proper operation of sand and other materials handling equipment is indicated by a centrally located signal panel which flashes a warning in case of breakdown or interference.

Two sets of equipment are located in the sand tower, one for the squeezer molding area, the other for the intermediate and slinger loops. Sand storage capacity

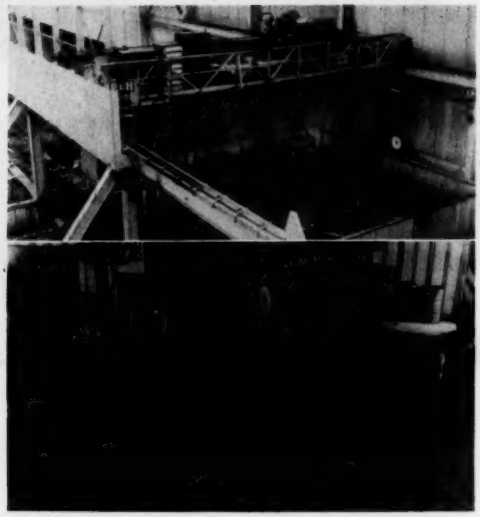


▶ Molding sand from the 6th floor of the sand tower enters the cooling barrel (upper right) and from there passes to the 4th floor where the 125-ton storage bins are located. Sand mixers (right) are on the 3rd floor.

▼ Conditioned sand (lower right) moves by 2nd-floor belt to molding areas. Shakeout and return sand reach ground floor screening barrel via upper conveyor (below); bottom conveyor returns sand to tower.

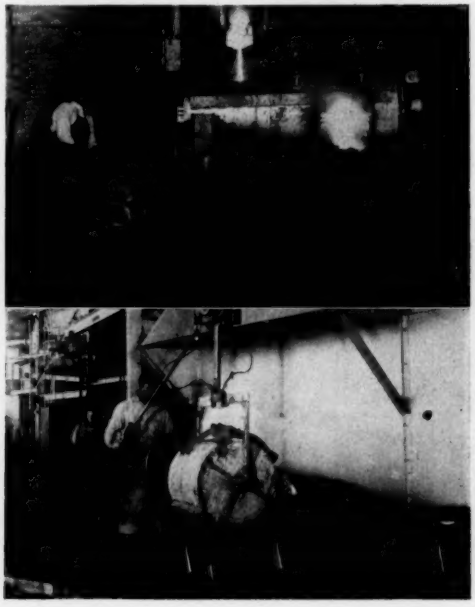


MODERN FOUNDRY METHODS...



5-ton charging crane drops scrap and pig through charging platform to charging bucket on ground level. 4-car merry-go-round enables operator to charge cupola while other buckets are being filled by outside crane.

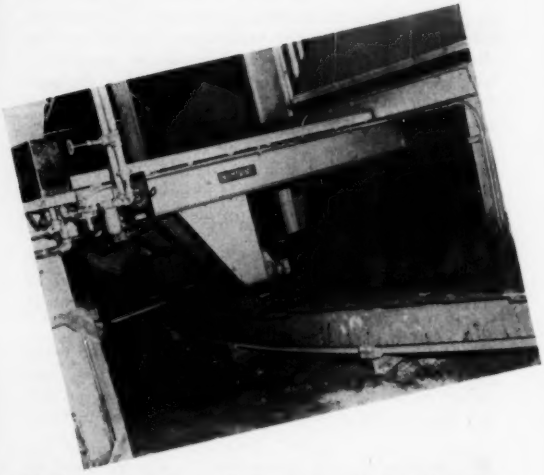
Molten metal is transferred to pouring stations by 6000-lb ladle mounted on truck. 6-ton receiving ladle catches iron continuously from cupola. Molds are poured from insulated, covered ladles suspended on monorail.



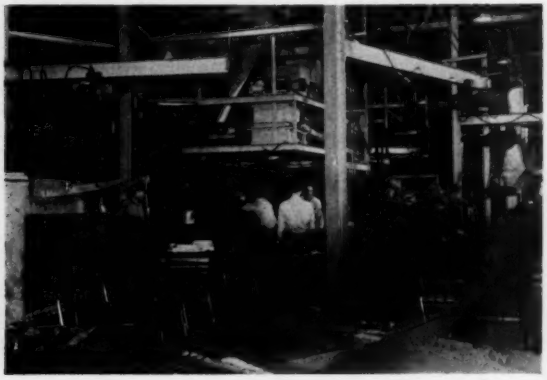
is provided through four 125-ton bins; each of the four mixers has a capacity of 3000 lb. Conditioned sand is aerated and distributed to the molding machine hoppers by overhead belt conveyor.

Metal charge materials are stored in a yard 110 x 682 ft, served by two 10-ton cranes. Charge makeup is facilitated by a 5-ton crane which loads scrap and pig into cone-bottom buckets positioned over a scale below a conical hole in the charge makeup floor.

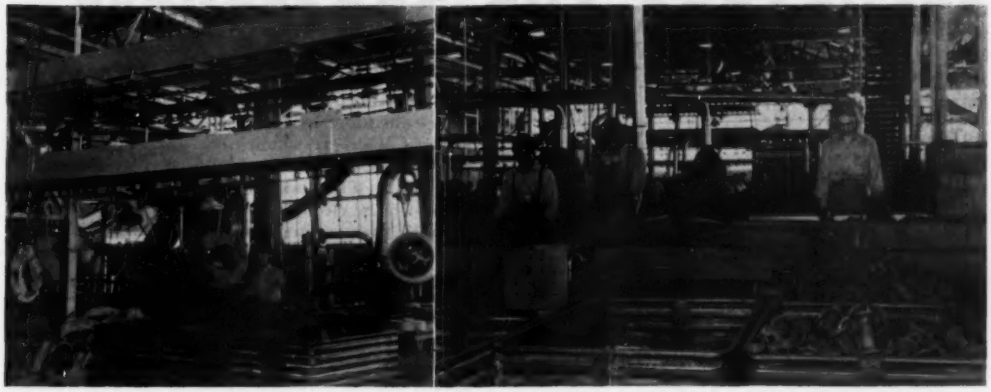
Cupola metal is tapped continuously at about 2800 F and distributed by ladle truck. Metal composition of the iron, which is inoculated, is kept very close to: C, 3.35 per cent; Si, 2.00; Mn, 0.65; S, 0.12 max; P, 0.50 max. Standard control tests are used and regular analyses are made in the laboratory which serves the entire plant from a separate building. Molding facilities are highly flexible. The slinger loop for 80 to 300-lb castings has



Ram pushes drags off slinger conveyor to automatic shakeout. Drags return to molding unit (left, below); castings go to cleaning department via chain conveyor. Double slinger unit has four cope and four drag machines.



...MODERN FOUNDRY METHODS



⬆ Rough castings from slinger unit are transferred to shot blast conveyor from chain conveyor. At right, sorting small castings off conveyor from squeezer unit shakeout.

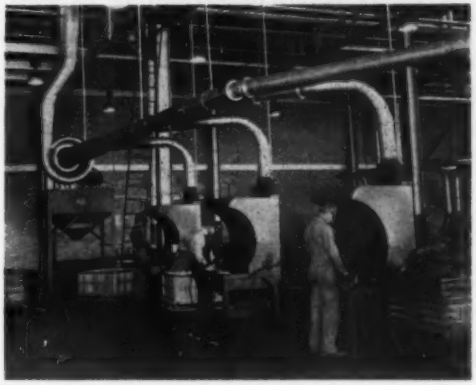
two stationary sand slingers, each with a turntable holding four cope or drag machines.

The intermediate unit has three cope and three drag machines. The snap flask unit achieves flexibility through six conveyor loops, each supplied with molds from four jolt-squeeze pin-strip and three jolt-squeeze machines.

Molds, poured at exhausted pouring stations, cool in ventilated tunnels. Large castings from the slinger unit move to the cleaning department by means of a chain conveyor. Heavy castings are blasted; lighter castings which are shaken out on an under-floor pan conveyor come up to work level in the cleaning department where sprues are removed and castings are sorted. Smaller castings are cleaned by tumbling.

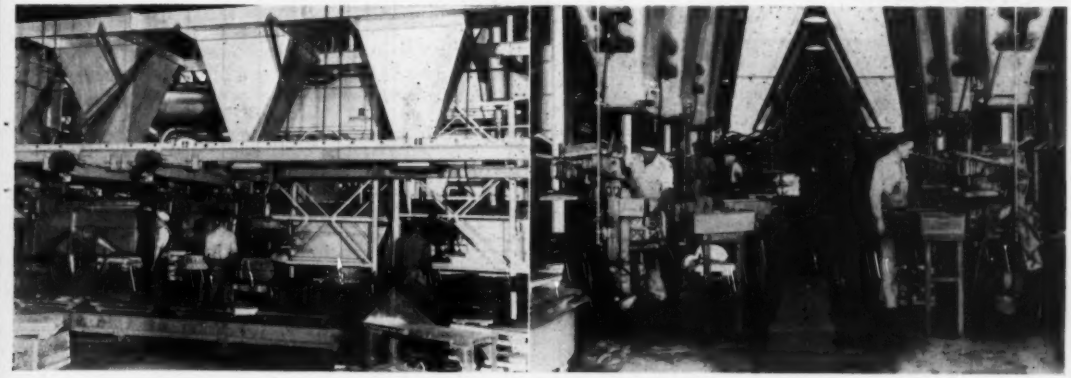
Finished by grinding and chipping, the castings pass through inspection and are transferred to the machining and assembly departments.

⬇ Grinding booths for small castings have forced-draft ventilation, ample work and storage space. Wood block floor is used largely throughout the Memphis foundry.



⬇ The intermediate molding unit makes molds in tight and snap flasks. Three cope and three drag machines are used. Exhausted cooling tunnel is in background.

⬇ Two of the six snap flask units. In foreground are jolt-squeeze machines; jolt-squeeze pin-strip machines are in background. Units give high degree of flexibility.



SET UP STEEL CASTING WELDING STANDARDS AND PROCEDURES

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INDUSTRIAL AND ENGINEERING applications of various materials require production of castings of increased quality and strength. Some specifications require that weldments made in the repair of steel castings possess physical properties similar to those of the parent metal. No doubt more specifications will follow this trend. In addition, the trend is to include radiographic inspection for quality of weldments with respect to pinhole porosity, cracking, and fusion.

With this in mind, our company has been striving to increase the shop standards of all operations in the foundry to produce castings of increased quality. A long-range welding study was initiated with the ultimate goal of increased quality of weld repairs. This study did not take into consideration only the soundness of the weld, but composition and physical properties of the weld steel, effect of weld and section size and subsequent heat treatment on the hardness and microstructure of the weld and heat-affected zone, and effect of welding on the strength of the casting. The results of this study would aid in setting up standards and procedures in the foundry.

A portion of this work has been reported previously.* Since that time, however, the study has been extended to other steels, and this paper will summarize all the work performed to date.

The initial step in the study of each steel was to find electrodes which would give welds possessing a satisfactory degree of soundness, and whose weld deposit would possess certain minimum physical properties after heat treatment. A metallurgical study was then made to study the effects of section size, single and multi-pass welding, and post-heat treatment on the hardness and microstructure of the weld metal and heat-affected zone.

Following are the compositions of the three steels used in this investigation:

Steel	Average Composition, % C	Mn	Si
Plain Carbon (Grade "B")	0.28	0.75	0.45
Intermediate-Manganese (Grade "C")	0.29	1.60	0.45
0.40 Carbon ("1040")	0.40	0.75	0.45

The foregoing steels are employed to meet the following minimum properties after heat treatment:

	Grade "B"	Grade "C"	"1040"
Yield Strength, psi	38,000	60,000	40,000
Tensile Strength, psi	70,000	90,000	80,000
Elongation, %	24.0	24.0	17.0
Red. of Area, %	36.0	45.0	25.0

* E. La Grelius and J. D. Wozny, "Techniques of Quality Welding of Plain Carbon Steel Castings," A.F.S. TRANSACTIONS, vol. 56, pp. 543-552 (1948).

NOTE: This paper was presented at the Wisconsin Regional Foundry Conference, sponsored by A.F.S. Wisconsin Chapter and University of Wisconsin, in Milwaukee, Feb. 8-9, 1951.

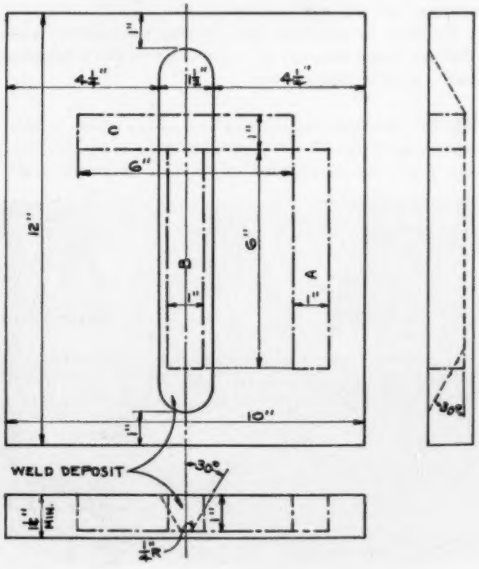
Procedure for Investigation of New Electrodes: The first problem entailed in the investigation of new electrodes was to set up a uniform welding procedure. A welder's qualification test plate (Fig. 1) was adopted after a review of literature and considerable preliminary study. The plate was to be of the grade of steel for which the electrode was to be used in production, with the groove either cast or machined to size.

Two prerequisites were set up for acceptance or approval of new electrodes for use in the foundry—soundness, and physical properties of the weld metal. A standard exograph for soundness was recommended (Fig. 2). This radiographic standard did not permit cracks, lack of fusion, or pinhole porosity of any greater concentration than shown in the standard.

The physical properties of the weld deposit were obtained from 0.505-in. tensile bars, which were removed from the weld plate as is shown in Fig. 1. All plates were welded in the normalized condition and physical properties of the welds were obtained after a heat treatment similar to that which the castings received in production. The physical properties of the weld metal had to equal or exceed the minimum physical properties required of the parent metal.

Influence of Electrode Coating: During the preliminary part of this investigation, considerable porosity,

Fig. 1—Sketch of the weld procedure qualification test plate. (A)—Parent metal tensile specimen. (B)—Longitudinal weld metal tensile specimen. (C)—Transverse weld metal-heat affected zone tensile specimen.



as shown in Fig. 3, was noted in welds made in cast steels with electrodes having organic or cellulosic coatings (AWS, E-XX10 and E-XX11 grades). This type of defect was less prevalent when the same steels were welded with electrodes having mineral or lime type coatings (low-hydrogen electrodes).

Low-Hydrogen Electrode Selected

A more detailed investigation was made of several electrodes that were in use to determine if this effect was produced by all organic-coated electrodes. From this study it was concluded that only electrodes that are lime or mineral coated would comply with the proposed radiographic standard.

This study also revealed that for our presently used steels no electrodes normally manufactured at that time would be acceptable. A long-range program was then planned to obtain electrodes that would:

1. Produce welds which would comply with the proposed radiographic standard of soundness.

2. Produce welds which after heat treatment would possess minimum physical properties of the parent metal.

3. Have good welding characteristics so that uniform welds could be produced by the welders in the plants.

The problem was discussed with several electrode manufacturers, advising them of revised specifications, radiographic standard for the welds, and proposed studies and investigations.

Meeting Physical Properties in the Weld Metal—Plain Carbon Steel (Grade "B"): One electrode manufacturer proceeded to make sample electrodes, and later several others cooperated. The first manufacturer submitted eight types of experimental electrodes before producing one which was finally accepted and placed in use at the author's various plants.

Table 1 lists in chronological order the physical properties and chemical composition of weld metal of the various experimental electrodes submitted during the investigation. Each of the electrodes was used to weld the groove of the plate shown in Fig. 1. After welding all plates were machined smooth before x-raying to prevent false indications during radiographing. No physical properties were obtained from any weld unless the radiographic soundness standard was met. All physical properties listed are from all-weld metal longitudinal specimens removed as shown in Fig. 1.

Electrodes 1 and 2 produced welds which did not meet the minimum tensile strength in the normalized state, while electrode 3 was rejected due to its high as-welded tensile strength. Electrode 4 met requirements and was recommended to the plants for qualification of their welders. Electrode 4A was a sample from the manufacturer's shipment to the plants. Laboratory and plant results showed a low tensile strength after normalizing. The electrode manufacturer submitted two more samples (5 and 6), both of which complied with specifications. Sample 7 was submitted to the plants, and also was satisfactory. It was then adopted for use in repair welding of plain carbon steel castings.

Since that time investigations have been made of a great number of additional electrodes, and five other rods were found which met the requirements set up for repair welding of plain carbon steel castings. Table 2 lists the physical properties and chemical analysis of the weld deposits made with the latter electrodes. Generally these electrodes will fall in the AWS-B7015 or 7016 class, although some fall in the E-9015 or 9016 class. Dependence cannot be placed on the latter classification for choosing the appropriate electrode for an application such as ours because of the normaliz-

TABLE 1—PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF WELD METAL FROM EXPERIMENTAL ELECTRODES IN THE DEVELOPMENT OF A SATISFACTORY ELECTRODE FOR PLAIN CARBON STEEL

Electrode Code	Yield Strength, psi	Tensile Strength, psi	Elongation, %	Red. of Area, %	Composition, % C	Mn	Si	P	S	Ni	Cr	Mo
1. AW	58,000	69,000	32.1	74.2								
N	41,100	57,200	44.5	72.6	0.08	0.52	0.11	0.030	0.025	—	—	—
2. AW	65,500	75,000	30.0	64.7								
N	43,000	61,000	39.0	74.0	0.10	0.52	0.27	0.009	0.032	—	—	0.40
3. AW	85,500	103,000	24.0	58.2								
N	51,000	78,000	31.0	59.6	0.12	0.68	0.22	0.010	0.031	—	0.90	0.45
4. AW	74,500	86,300	28.0	62.3								
N	47,700	70,300	31.5	73.5	0.14	0.70	0.36	0.019	0.022	0.12	—	0.52
4A. N	45,500	67,300	39.0	74.9	0.11	0.65	0.32	0.014	0.026	—	0.02	0.40
5. AW	82,000	93,500	20.0	50.0								
N	66,800	77,400	28.8	68.8	0.17	0.74	0.43	0.012	0.026	0.18	0.25	0.39
6. AW	87,300	101,000	21.0	49.1								
N	63,000	74,500	30.5	56.2*	0.18	0.73	0.42	0.014	0.024	0.19	0.41	0.39
7. AW	80,000	95,700	23.5	66.8								
N	66,000	76,900	37.5	73.9	0.13	0.71	0.40	0.014	0.025	—	0.41	0.46

*Defect in weld metal
AW As welded
N Normalized after welding 1650F for 2 hr and air cooled. All bars aged at 400F for 16 hr and air cooled.

TABLE 2—PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF WELD METAL FROM PLAIN CARBON STEEL CASTINGS

Electrode No.	Yield Strength, psi	Tensile Strength, psi	Elongation, %	Red. of Area, %	Composition, per cent C	Mn	Si	Cr	Mo	Ni	V
8	53,300	73,800	34.5	72.9	0.12	0.90	0.56	0.03	0.06	2.34	—
9	53,200	75,600	35.0	66.5	0.11	1.36	0.57	0.07	0.11	0.13	0.09
10	53,600	78,000	35.5	67.7	0.12	0.81	0.66	0.04	0.65	0.12	0.04
11	50,600	78,200	36.0	63.3	0.11	0.96	0.37	0.70	0.46	0.15	—
12	50,000	72,000	34.0	63.2	0.14	0.70	0.65	—	0.46	0.01	—

Electrodes 8 to 11 inclusive, DC; electrode 12, AC.
Above physical properties obtained from longitudinal specimens removed after normalizing at 1650F.
All bars aged at 400F for 16 hr before testing.

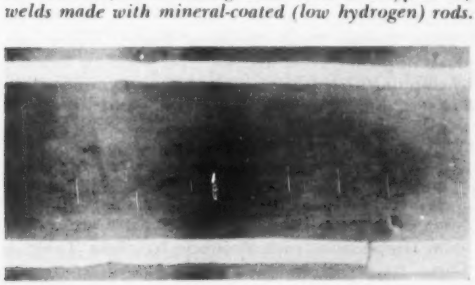


Fig. 2—Recommended radiographic standard for soundness of steel casting welds which is typical of welds made with mineral-coated (low hydrogen) rods.

Fig. 3—This radiograph of a steel weld zone shows typcial pinhole porosity found in cast steels welded with electrodes having organic or cellulosic coatings.

TABLE 3—PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF WELD METAL FROM INTERMEDIATE MANGANESE STEEL CASTINGS

Electrode No.	Yield Strength, psi	Tensile Strength, psi	Elongation %	Red. of Area, %	Composition, per cent C	Mn	Si	Cr	Mo	Ni	V
13	62,100	90,600	26.0	64.2	0.09	1.48	0.50	—	0.36	1.70	0.02
14	67,000	92,600	24.5	66.3	0.12	2.36	0.65	0.09	0.01	0.16	0.10
15	72,000	95,000	29.0	65.6	0.10	0.60	0.47	0.06	0.50	1.73	—
13a	64,000	91,500	23.0	64.7	0.10	1.56	0.42	—	0.44	1.59	—

Electrodes 13 and 14, DC; electrodes 15 and 13a, AC.
Above physical properties obtained from longitudinal specimens removed after normalizing at 1650F and tempering at 1050F
All bars aged at 400F for 16 hr before testing.

ing operation after welding. This subject will be discussed in more detail later in the paper.

Intermediate Manganese (Grade "C" Steel: After several electrodes were approved for plain carbon steel, work was initiated to find satisfactory electrodes for repair welding of Grade "C" castings (intermediate-manganese steel). The prerequisites for these electrodes were similar to those for the plain carbon steel. The weld deposit had to be sound and free of pinhole porosity, and had to possess, after normalizing and tempering, physical properties similar to those required of the parent metal.

To date three electrodes have been found which satisfactorily meet requirements. One of these electrodes has been qualified for AC-DC welding, one for DC, and one for AC welding only. Table 3 lists the physical properties and chemical analysis of the weld deposit.

Matching Chemical Composition and Physical Properties of Parent Metal: To date we are not obligated under any specification to make weld deposits whose chemical analyses are similar to the parent metal. However, with increasing demands for better quality in the industry in general, this requirement might be forthcoming for certain applications. The matter was discussed with a very cooperative welding manufacturer, and in a short time electrodes were supplied which deposited weld metal to match the compositions of three steels. After heat treatment similar to that which the castings receive, the weld metal deposit also met the physical properties required of those particular steels (Table 4).

Recently an application was found for the 0.40 C electrode in one plant which is producing a casting of a modified "1040" steel. One face of this casting is hardened by the induction method to 58 Rockwell "C". Until recently no repair welding was permitted on this face. However, a deviation has been obtained which allows a certain amount of welding providing the weld deposit responds to heat treatment similarly to the parent metal so that similar hardnesses can be obtained during the hardening treatment.

Without further investigation it was apparent that the approximate analysis of the parent metal could be matched with the 0.40 C electrode. Weld passes were made in a plate of the subject composition and same thickness as the face of the casting. The plate was hardened and a hardness survey made, which showed identical hardnesses for the weld metal and parent metal.

Other applications of these electrodes probably will be found, especially in instances where the castings require a hardening treatment to meet the required physical property requirements.

TABLE 4—PROPERTIES AND COMPOSITION OF WELD METAL FROM ELECTRODES MATCHING PARENT METAL COMPOSITION

Electrode No.	Yield Strength, psi	Tensile Strength, psi	Elongation %	Red. of Area, %	Composition, per cent C	Mn	Si	P	S
16	48,000	72,000	35.0	64.7	0.22	0.86	0.40	0.011	0.024
17	69,000	103,000	24.5	51.4	0.30	1.80	0.36	0.022	0.030
18	52,000	88,000	23.0	40.1	0.37	0.86	0.44	0.010	0.024

Transverse and Longitudinal Physical Properties of Weld Metal: In listing the physical properties of the weld metal deposits only the longitudinal all-weld metal results were included, although the transverse weld metal properties also were studied. The transverse properties were not listed due to the lower elongation values that were obtained. The weld metal in the transverse bars did not cover the entire 2-in. length, so that in testing the bar the weld metal, heat-affected zone, and parent metal within the 2-in. gage mark were all tested simultaneously This brought a complexity into the testing and true elongation values were not obtained.

To illustrate this effect, transverse pull bars were removed from plain carbon steel welds of varying widths (Fig. 4) so that ½-, 1-, 1½- and 2-in. widths of

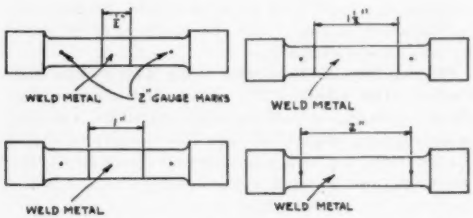


Fig. 4—Positions of welds in plain carbon cast steel tensile test bars which were used to study the effects of widths of welds on transverse ductility properties.

weld metal were obtained within the 2-in. gage marks. The following physical properties were obtained from these bars in the normalized condition:

	100% Parent Metal	Width of Weld Metal in 2-in. Gage Mark ½ in.	1 in.	1½ in.	2 in.
Yield Strength, psi	50,100	44,000	42,100	42,100	41,000
Tensile Strength, psi	80,000	73,800	71,500	71,000	70,000
Elongation, %	30.0	23.0	27.0	28.0	30.0
Red. of Area, %	54.7	69.0	71.2	70.8	72.3

The elongation value increased with the width of the weld until it compared with the parent metal at the 2-in. width.

Plain Carbon Steel—Hardness Study: Three cast plates of plain carbon steel were prepared for welding by chipping "U" grooves of the following dimensions:

Plate Size, in.	Small Groove, in.	Large Groove, in.
½x9x11	¼x½x1	⅜x1x2
1x9x11	½x1x2	¾x2x4
2x9x11	1x2x4	1½x4x8

The size of the grooves was arbitrarily set to approximate minor and major welds in the plates of the three different thicknesses. The grooves were welded at room temperature with electrode No. 7 in Table 1. Three transverse sections were removed from each

weld and were given the following post-heat treatment: Section No. 1—no treatment; Section No. 2—1050F, 2 hr, air cooled; Section No. 3—1650F, 1 hr, air cooled.

For additional information sections from the 2-in. plates minor and major welds were tempered at 1150F, 1250F, 1300F, and 1350F. A hardness survey was made across the weld and heat-affected zone and specimens were removed for microscopic investigation.

Results of the hardness survey are summarized in Tables 5 and 6. The hardness readings of all the one-pass welds have been combined to form the curves shown in Fig. 5. Tables 5 and 6 show that a definite correlation exists between the hardness of the heat-affected zone and the thickness of the section welded, as well as the size of the weld.

In the as-welded state the maximum hardness of the weld and heat-affected zone increased with the section size of the plate, the hardness of the weld being 230 Brinell in the ½-in. plate, 240 in the 1-in. plate, and 270 in the 2-in. plate. The hardness of the heat-affected zone increased from 200 to 230 and 250 Brinell.

As shown in Fig. 5, tempering had little effect on the hardness of the welds, although the hardness of the heat-affected zone was reduced considerably. Normalizing reduced the hardness of the weld and heat-affected zone to the original hardness of the parent metal.

TABLE 5—BRINELL HARDNESS SURVEY OF WELDS MADE IN PLAIN CARBON STEEL

Weld	BHN As Welded	Normalized 1650 F, 2hr, Air Cooled	1050 F, 1hr, Air Cooled	1150 F, 1hr, Air Cooled	1250 F, 1hr, Air Cooled	1300 F, 1 1/2 hr, Air Cooled	1350 F, 1hr, Air Cooled
2-in. Major							
Weld	176-228	135-141	180-216	176-216	169-285	162-285	165-200
H. A. Z.	185-210	156-153	180-216	169-176	159-169	153-162	165-169
P. M.	159-162	159-162	159-162	153-156	147-150	144-147	153-156
2-in. Minor							
Weld	176-210	139-144	176-216	172-216	169-216	165-205	162-200
H. A. Z.	195-205	159-162	185-210	169-176	162-176	159-172	172-176
P. M.	159-162	159-162	156-165	153-156	147-150	144-147	153-156
1-in. Major							
Weld	159-195	137-153	159-195				
H. A. Z.	169-185	165-150	165-185				
P. M.	159-162	159-162	159-162				
1-in. Minor							
Weld	210-216	150-159	204-222				
H. A. Z.	205-210	153-162	195-209				
P. M.	159-162	159-162	158-162				
½-in. Major							
Weld	195-228	156-162	195-234				
H. A. Z.	195-205	156-162	176-195				
P. M.	159-162	159-162	159-162				
½-in. Minor							
Weld	205-228	159-169	200-234				
H. A. Z.	195-200	159-162	160-205				
P. M.	159-162	159-162	159-162				

H. A. Z. Heat-affected zones.
P. M. Unaffected parent metal.

TABLE 6 EFFECT OF TEMPERING ON HARDNESS OF MULTI-PASS WELDS

	As Welded	1050F, 1hr, A.C.	1150F, 1hr, A.C.	1250F, 1hr, A.C.
BHN Near Top of Weld				
2-in. Major Weld	228	216	216	210
2-in. Minor Weld	216	216	216	216
1-in. Major Weld	228	228	222	222
1-in. Minor Weld	228	228	228	222
Unaffected P. M.	162	162	156	150
BHN Near Top of Heat-Affected Zone				
2-in. Major Weld	207	210	176	169
2-in. Minor Weld	210	210	176	176
1-in. Major Weld	205	200	170	170
1-in. Minor Weld	200	195	170	170
Unaffected P. M.	162	162	156	150

The effect of multi-pass welding is shown in Fig. 6. The hardness in the weld and heat-affected zone increases gradually from the bottom to the top of the weld. The reduction of the hardness at the bottom of the weld depends upon the number of weld passes, the reduction being greater when more passes are made. This effect of hardness reduction is due to the renormalizing effect of succeeding passes. The top passes will have a higher hardness which approaches the hardness of the single-pass welds.

Physical properties of welds in the as-welded state, as reported by electrode manufacturers, are the properties of the weld in the location from which the test specimen is removed. Actually the tops of multi-pass welds, and especially single-pass welds, will have higher tensile strength and lower ductility.

The same holds true for the reported properties in the stress-relieved state. It was shown that tempering reduced the hardness of the weld only slightly. Due to the hardness differential between the top and bottom of the weld, the tensile strength of the top of the weld will be 25,000 to 30,000 psi higher and ductility correspondingly lower than the values reported by the welding manufacturer.

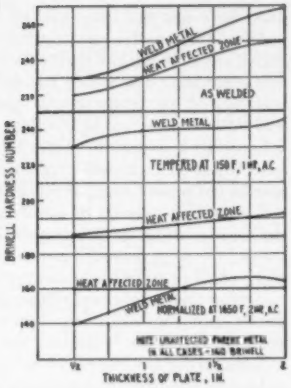

WELD METAL
HEAT AFFECTED ZONE
AS WELDED
WELD METAL
TEMPERED AT 1150 F, 1 HR, A.C.
HEAT AFFECTED ZONE
HEAT AFFECTED ZONE
WELD METAL
NORMALIZED AT 1650 F, 2 HR, A.C.
NOTE: UNAFFECTED PARENT METAL IN ALL CASES = 160 BRINELL
BRINELL HARDNESS NUMBER
THICKNESS OF PLATE, IN.

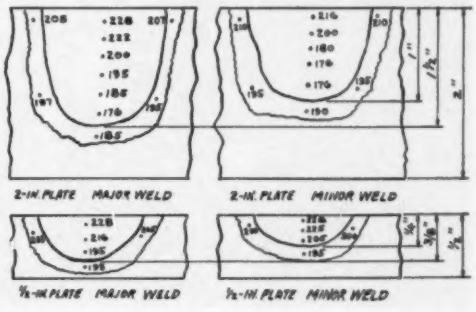
Fig. 5—Effect of section size on hardness of weld and heat-affected zone for one-pass welds in Grade B cast steel.

The hardness of the weld in most cases will be lower after normalizing as compared to the as-welded or tempered state. If the welded castings are to be normalized, the hardness of the weld and the corresponding tensile strength will be lower than in the as-welded or tempered (or stress-relieved state). For this reason we cannot choose the appropriate electrode from the AWS electrode designations, which are based on the stress-relieved state of the weld.

The difference in tensile strength of the weld metal between the stress-relieved and normalized states will vary among the different rods in the same AWS class, depending on the composition of the weld metal deposit. If such data are not available, an investigation must be made before an appropriate electrode can be selected for a particular steel.

Grade "B" Steel—Microstructure Study: Figure 7 illustrates the changes in microstructure of the heat-affected zone. Adjacent to the weld metal is a thin layer of a very coarse pearlitic structure. This area

Fig. 6—Cross-sectional hardness survey made in the weld metal and heat-affected zones of major and minor welds, ½-in. and 2-in. plates, Grade B cast steel.



must have reached temperatures in excess of 2100F in order to form such a coarse structure in an aluminum-killed steel. Adjacent to the latter structure is a very fine grain structure which was formed when the metal was heated to temperatures just above the critical and followed by rapid cooling. Next is an area of spheroidized structure which formed at temperatures just below the critical (approximately 1350F). The unaffected parent metal is on the extreme right.

The above pattern of structure was found around the entire weld in single-pass welds. In multi-pass welds, due to grain refinement caused by the renormalizing effect of succeeding passes, the above pattern will be found only at the top of the weld. The initial weld passes and the adjoining heat-affected zone will be refined toward the bottom of the weld (Fig. 8).

Tempering has no effect on the microstructure obtained by welding. Normalizing (Fig. 9) will refine the entire heat-affected zone. All of the above welds were made at room temperature. Etching of various cross sections and radiographing all the welds did not reveal evidence of cracking in the heat affected zone or weld metal.

Grade "C" Steel—Hardness Study: The effect of welding on the intermediate-manganese steel is similar to that of the plain carbon steel. Due to increased hardenability caused by the higher manganese content much higher hardnesses are obtained in the heat-affected zone of the medium-manganese steel.

Factors Affecting Hardness

The effect of section size on the hardness in the heat-affected zone is illustrated in Fig. 10. In the one-pass welds the heat-affected zone hardness increased from 300 Brinell in the ½-in. plate to 340 in the ¾-in. plate, and up to 495 Brinell in the 2-in. plates, due to the increased cooling rates in the heavier sections. Due to the greater hardenability of the intermediate-manganese steel, the increased cooling rate has a more pronounced effect on the hardness. The 495 Brinell hardness can be reached in a 2-in. section of this steel only by a drastic water quench.

The effect of multi-pass welds on the hardness in the heat-affected zone is shown graphically in Fig. 11. In the 2-in. plate the minimum hardness of the heat-affected zone drops from 495 in a one-pass weld to 385 Brinell in a three-pass weld, and to 340 Brinell in the five-pass weld. The drop in hardness in the lighter

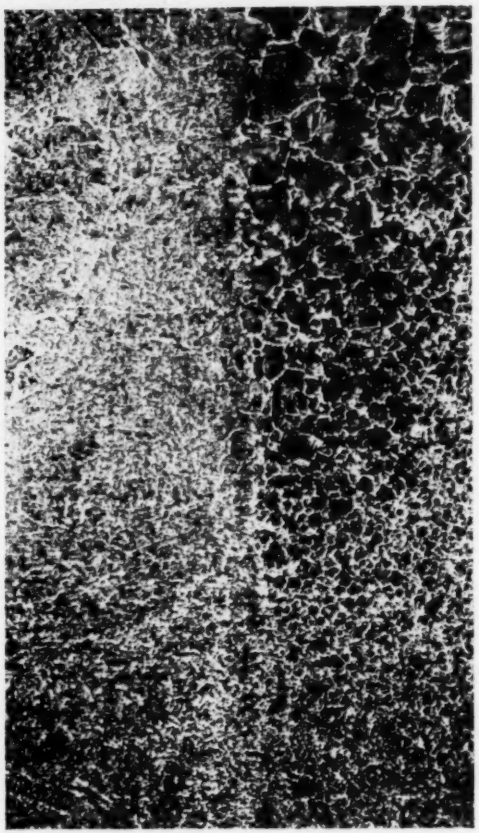
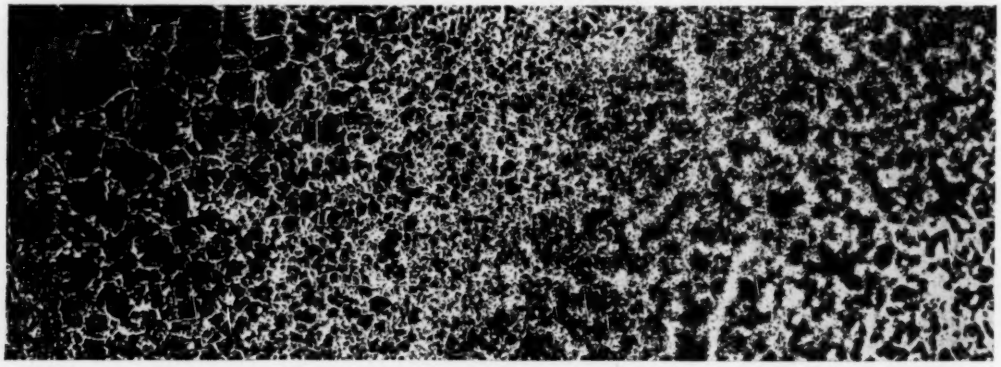


Fig. 8—Grain refining effects of multi-pass welding in plain carbon steel are shown by the structures of the weld metal and heat-affected zone of the initial passes. Weld metal is on the left, and initial weld metal at the bottom of the micrograph. Nital etch. X100.

Fig. 7—Microstructure of the weld and heat-affected zone of a one-pass weld made in plain carbon steel. The weld metal is on the extreme left. Nital etch. X100.



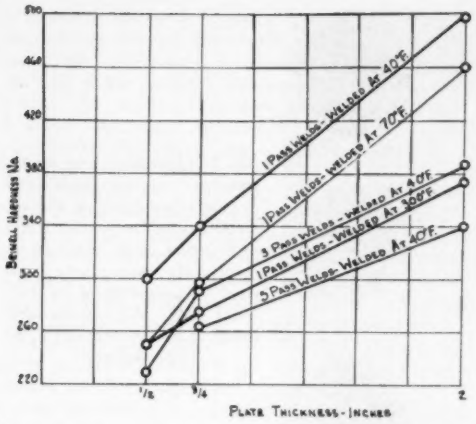
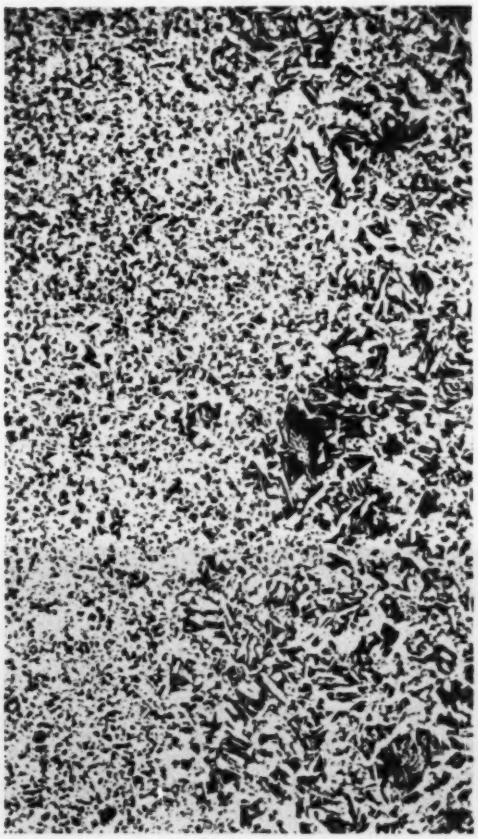

Brinell Hardness No.
Plate Thickness - Inches
1 Pass Welds - Welded At 40°F
1 Pass Welds - Welded At 70°F
3 Pass Welds - Welded At 40°F
1 Pass Welds - Welded At 300°F
3 Pass Welds - Welded At 40°F

Fig. 10—Effects of various section sizes on heat-affected zone hardnesses (max.) of one-pass and multi-pass welds made in intermediate-manganese cast steel.

Fig. 9—Normalizing effect on heat-affected zone and weld metal of multi-pass weld in plain carbon cast steel.



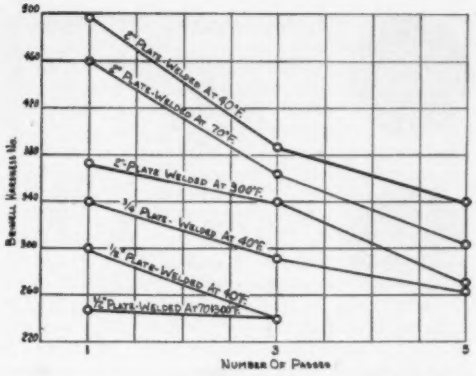

Brinell Hardness No.
Number Of Passes
2" Plate-Welded At 40°F
2" Plate-Welded At 70°F
2" Plate Welded At 300°F
1" Plate - Welded At 40°F
½" Plate-Welded At 40°F
½" Plate-Welded At 70-300°F

Fig. 11—Heat-affected zone hardnesses (max.) as affected by number of weld passes in intermediate-manganese cast steel plates of various section thicknesses.

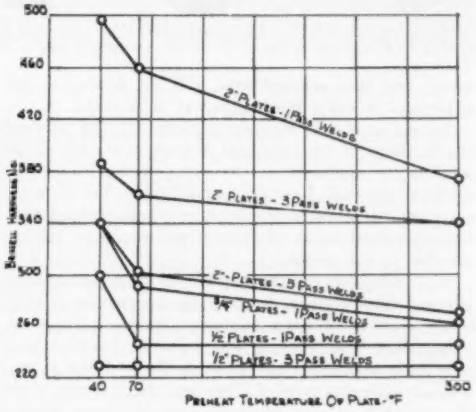

Brinell Hardness No.
Preheat Temperature Of Plate - °F
2" Plates - 1 Pass Welds
2" Plates - 3 Pass Welds
1" Plates - 3 Pass Welds
1" Plates - 1 Pass Welds
½" Plates - 1 Pass Welds
½" Plates - 3 Pass Welds

Fig. 12—Preheat temperature effect on heat-affected zone hardness of intermediate-manganese cast steel.

sections is not so significant—even in the one-pass weld the hardness is much lower.

Figure 12 illustrates the effect of preheating on the maximum hardness in the heat-affected zone. In the ½-in. plate preheating had little or no effect on the hardness. In the 2-in. plate the effect of preheating is pronounced. In the one-pass weld the hardness in the heat-affected zone was decreased from 495 to 375 Brinell by increasing the preheat temperature from 40F to 300F.

Preheating has little effect in the lighter sections because the heat of the welding operations heats the section sufficiently to act as a preheat, while in the heavier sections such as the 2-in. plate the greater mass of metal is capable of absorbing a great quantity of heat, thus sufficiently increasing the temperature.

The principle of preheating then is to increase the temperature of the metal around the location of the weld, thereby reducing its ability to extract heat from the weld. By this token, the cooling rate of the weld

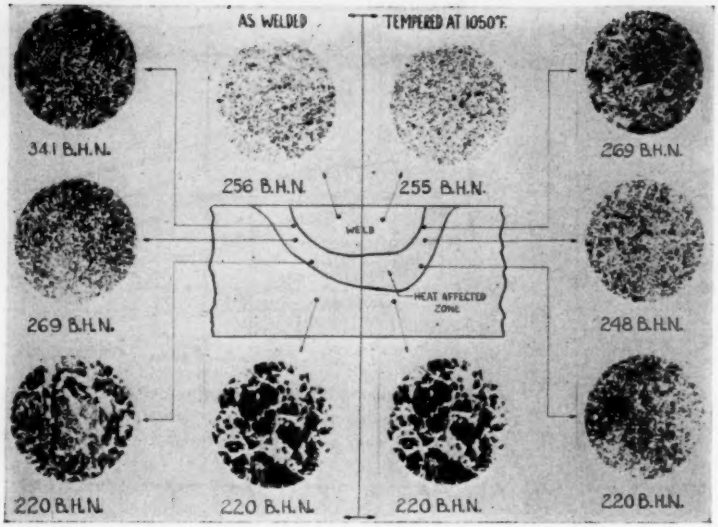


Fig. 13—Hardness and microstructure of the weld and heat-affected zone in the as-welded and tempered states of one-pass welds made in intermediate manganese cast steel at temperature of 40F. Nital etch. All micrographs made at X750 (reduced ¾ in reproduction).

metal and heat-affected zone will be decreased and structures of lower hardnesses will be formed.

Normalizing and tempering after welding reduced the hardness of the weld and heat-affected zone to the level of the unaffected parent metal. Tempering alone reduced the high hardness considerably, but in some cases the hardness of the weld and heat-affected zone still remained up to 50 Brinell points above the unaffected parent metal.

No cracks were disclosed in any of the welds or heat-affected zones as inspected by magnetic particle testing, x-ray, etching of cross sections, and microscopic investigation. The welding was performed with a lime type (low-hydrogen) electrode. If the welding is performed with this type of electrode, there is much less chance of hydrogen absorption in the heat-affected zone.

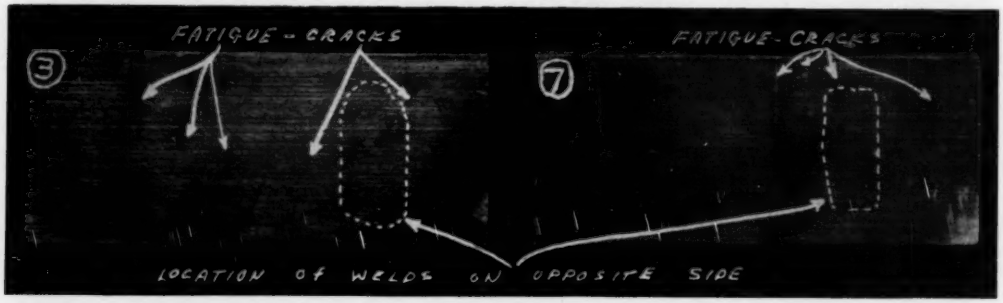
High hardness in the heat-affected zone coupled with a high hydrogen content produces cracking. Thus there is much less chance for underbead cracking when the welding is performed with the low-hydrogen electrodes. Many steels which are not weldable with the cellulose-coated electrodes without preheating are readily weldable with the low-hydrogen electrodes.

Intermediate-Manganese Steel—Microstructure Study: The changes in microstructure occurring during the welding of the intermediate-manganese steel present a much different picture than does the plain carbon steel. Figure 13 shows microstructures and hardnesses of the weld metal, three different locations of the heat-affected zone and the unaffected parent metal of a one-pass weld made in a ¾-in. section. The structures on the left are in the as-welded state, while on the right are shown the structures after tempering.

The structure of the heat-affected zone adjacent to the weld appears to be martensitic, while in the center of the heat-affected zone the structure appears to be pearlitic. Toward the bottom of the heat-affected zone the structure becomes spheroidized.

Testing Welded Castings: Since the results of the investigations indicated that castings of intermediate-manganese steel in sections up to ½-in. and ¾-in. thicknesses could be welded successfully without cracking or formation of excessively high hardness at tem-

Fig. 14—Sectioned endurance limit test bars of plain carbon steel show that locations of fatigue cracks are outside the welded areas. One of the fatigue cracks (right-hand specimen) runs into the area under the weld. Fig. 15 shows the fracture through this crack.



peratures as low as 40 F, experimental work was outlined where various size welds were made in castings of the subject steel. The size of welds varied from one-pass welds to welds through the entire casting section. All welding was done with approved low-hydrogen electrodes. Half of the welds were made after preheating the castings to 300 F, and the other half with the castings at 40 F.

The castings were then tested statically in the as-welded state, after tempering, and after normalizing and tempering. All castings passed the minimum required ultimate load of 500,000 lb. None of the breaks occurred through or adjacent to the welds. Subsequent hardness and microscopic study revealed results similar to those in the experimental work.

Customer specifications on the above castings require preheating to 300 F for welding. After completion of the investigation the customer was approached for the purpose of reducing the preheat requirements to 70 F, based on the experimental work. This deviation from the specification has not been obtained as yet, but the outlook is promising.

To study the effect of welding and post-heat treatment on the endurance limit of a plain carbon steel, welds were made in bars of a 0.30 carbon steel and tested on a fatigue testing machine in the as-welded state, after tempering, and after normalizing. The welds were made with an approved low-hydrogen electrode at room temperature in grooves ¼-in. deep, ⅜-in. wide and 1¼-in. long, machined in the centers of $^{13}/_{16}$-in. thick bars. The welded bars were machined to ½-in. thickness after heat treatment to eliminate any effects of decarburization and surface defects.

The results of these tests indicate that neither the weld nor post-heat treatment had any effect on the endurance limit of the 0.30 carbon steel. The endurance limits in all bars tested were approximately the same, running from 25,000 to 27,000 psi. The failures, in each case, occurred outside the weld or heat-affected zone, as shown in Figs. 14 and 15.

Significance of Experimental Work in Establishing Shop Procedures: It has been shown that with proper electrodes sound welds can be made which will meet the minimum required physical properties of plain carbon steel, intermediate-manganese steel, and a 0.40 carbon steel. It has also been shown that it is possible to obtain electrodes whose weld deposit composition can match the composition of the parent metal of the three subject steels.

The metallurgical study has shown that plain carbon cast steel (within the chemical range of the steel investigated) can be welded without preheating, at least to the maximum section size used in this study. The intermediate-manganese steel can be welded with the low-hydrogen electrodes without preheating, at least up to 1-in. sections.

Normalizing after welding restores the original structure in the heat-affected zone and reduces the hardness of the weld and heat-affected zone to the hardness level of the parent metal. Tempering reduces the hardness of the heat-affected zone considerably, but reduces the hardness of the weld metal only slightly. A hardness difference between the weld and parent metal will exist after tempering, the magnitude depending upon the size of weld and size of section welded.

For example, in the single-pass weld made in the 2-in. section of the plain carbon steel, there was a hardness difference to 110 Brinell points between the weld and parent metal after tempering at 1150 F for 1 hr. The resulting question is, "What effect will this hardness difference have on machining?" In an experiment at the laboratory a one-pass weld was made in a slotted 1-in. diameter bar. A hardness difference of 84 Brinell points existed between the parent metal and weld, but no machining difficulties were encountered when the bar received the most drastic machining possible at the laboratory.

Show Operating Results

The most important fact in this type of study is that it shows the results of the various operating conditions in the foundry. If the casting requirements are known —service, machineability, etc., procedures can be set up instantly to obtain the desired characteristics in the casting. General shop standards also can be set up easier and logically if all such conditions are known. For example, many procedures for preheating and post-heat treatment are set up on the belief that the so-called major welds are much more critical than minor welds.

The results of this investigation show that with respect to hardness and microstructure, the small welds (especially one-pass welds) are more critical than the larger welds. When this fact was brought out by the investigation, the shop procedures and standards were altered accordingly. The quality of the repair welds in steel castings can be improved only if the effects of the various operations and variables connected with the repair welding are known in detail.

Fig. 15—Test bar fracture shows that the fatigue crack (Fig. 14) is entirely outside of the welded area.

Future Meetings and Exhibits

AMERICAN SOCIETY FOR QUALITY CONTROL, annual convention, Hotel Cleveland, Cleveland, May 23-24.

FRENCH FOUNDRY ASSOCIATION, foundry congress, Paris, France, June 4-6.

INSTITUTE OF BRITISH FOUNDRYMEN, foundry congress, Newcastle-on-Tyne, England, June 12-15.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chalfonte-Haddon Hotel, Atlantic City, N. J., June 18-22.

MALLEABLE FOUNDERS' SOCIETY, annual meeting, the Homestead, Hot Springs, Va., June 22-23.

DETERMINE SILICON-COPPER-IRON IN MONEL METAL

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New York Naval Shipyard
Brooklyn, N. Y.

A PROCEDURE for the determination of silicon, copper and iron in monel metal has been described by Clardy, Maupin, and Gibbs.[2] This procedure, although a great improvement over previously published procedures for the determination of these elements in monel metal,[4] is still rather lengthy.

In the procedure of Clardy, Maupin, and Gibbs a 2-gram sample is dissolved in nitric and perchloric acid, and the solution evaporated to fumes of perchloric acid to dehydrate the silicon. The silica is filtered off, and the filtrate heated to boiling and boiled several minutes to drive off the chlorine. The solution is cooled to room temperature, sulphuric acid and nitric acid are added, and the copper electrolyzed. The iron is determined volumetrically on the copper electrolyte after a double ammoniacal separation.

In this paper a method is proposed for the determination of silicon, copper, and iron in monel metal that requires only half the time of the above procedure. In this method a 1-gram sample is dissolved in nitric acid and perchloric acid, and is evaporated to fumes of perchloric acid as described by Clardy, Maupin and Gibbs.[2] The copper is electrolyzed directly on the silicon filtrate after the addition of nitric acid. The iron is determined colorimetrically on the copper electrolyte by a very rapid method using thiocyanate.

It was found by the authors that when a 1-gram sample was used, no significant amounts of chlorine were formed on fuming with perchloric acid. Consequently, it is not necessary to boil the silicon filtrate before electrolyzing for copper. In the thiocyanate colorimetric procedure for iron, hydrogen peroxide is used to stabilize the color as described by Peters, McMasters and French.[3] The authors are apparently the first to use a perchloric-nitric acid medium for the colorimetric determination of iron by the thiocyanate method.

If desired, other elements can be determined on the residual solution after the iron determination. Aluminum can be determined colorimetrically by the method of Carroll, Geld and Norwitz.[1]

Procedure

Transfer a 1-gram sample to a covered 300-ml beaker, and add 10 ml of nitric acid (70 per cent), 20 ml of perchloric acid (70 per cent) and 5 ml of water. Heat on the hot plate until the sample is dissolved, and then evaporate to fumes of perchloric acid and reflux for 15 min. Cool somewhat, and add 60 ml of water. Filter through a No. 41H Whatman filter paper, and collect the filtrate in a 300-ml electrolytic beaker.

Wash the silica precipitate with 1 per cent nitric acid solution, and ignite in the usual manner.[2] Add 7 ml of nitric acid (70 per cent) to the filtrate, dilute to 200 ml, and electrolyze for copper at 2 amperes per square decimeter for 1 hr. During the electrolysis stir the solution by some suitable means. With the current on, lower the beaker containing the electrolyte while rinsing the electrodes with a fine stream of water. Dip the cathode in water, and then in two portions of alcohol. Dry at 110 C for 3 min, cool, and weigh the deposit as metallic copper.

Dilute the electrolyte to exactly 250 ml, and pipette a 5-ml aliquot into a 100-ml volumetric flask. Add 1 ml of hydrogen peroxide (3 per cent) and swirl. Dilute to the mark with sodium thiocyanate solution (4 per cent) and shake. Read the color within 10 min at 470 millimicrons in a photoelectric colorimeter (1-cm cell) that has been set to zero with distilled water. Convert the readings to percentage of iron by consulting a curve prepared by use of standard or synthetic samples containing 0.01 to 3 per cent iron.

The results obtained for copper and iron in National Bureau of Standards sample 162 are shown in Table I. Silicon results are not included because Clardy, Maupin and Gibbs[2] have already established the accuracy and precision of the silicon procedure.

References

1. J. Carroll, I. Geld, and G. Norwitz, AMERICAN FOUNDRYMAN, Nov., 1949, p. 43.
2. F. B. Clardy, H. R. Maupin, and R. S. Gibbs, *Ind. Eng. Chem., Anal. Ed.*, 13, 88 (1941).
3. C. A. Peters, M. M. McMasters, and C. L. French., *Ind. Eng. Chem., Anal. Ed.*, 11, 502 (1939).
4. W. W. Scott, *Standard Methods of Chemical Analysis*, vol. II, p. 1378, (1939), D. Van Nostrand Co., New York.

TABLE I—RESULTS FOR COPPER AND IRON IN NATIONAL BUREAU OF STANDARDS MONEL SAMPLE 162

Composition, %	Copper Found, %	Iron Found, %
28.93 Cu, 0.34 Fe	28.92	0.34
0.67 Si, 2.34 Mn	28.90	0.34
0.24 Cr, 0.54 Co	28.93	0.35
0.23 Al, 0.20 Ti	28.95	0.34
66.38 Ni		

Publish New Cast Iron Design Book

ENGINEERING PROPERTIES OF CAST IRON, new 96-page publication of the American Foundrymen's Society released in December, is a concise, authoritative book on properties and applications of cast iron prepared under the auspices of the A.F.S. Committee on Symposium of Engineering Properties of Cast Iron. Prepared to provide design engineers with the latest data on cast iron, the new book will also be useful to foundrymen who wish to advise customers on uses and limitations of cast iron.

The paper-bound, 6 x 9 in. book is available to A.F.S. members at $2.25; non-member price is $3.50.

*Present address, 3353 Ridge Ave., Philadelphia, Pa.

NOTE: The opinions expressed in this article are those of the authors, and are not to be construed as representing the official views of the Navy Department.

Questions

THE ROUND TABLE

Answers

DISCUSS PREVENTING CASTING DEFECTS

This month's Round Table reports the informal discussion of a small group of Texas foundrymen who met in San Antonio as guests of AMERICAN FOUNDRYMAN to consider the causes and remedies of several casting defects. These men represent a cross section of the foundry industry, including patternmaking, and their remarks—recorded and reproduced below—portray the operating man's viewpoint.

W. H. Lyne: We are going to discuss some of the 31 defects described in the A.F.S. book entitled ANALYSIS OF CASTING DEFECTS with the idea of developing methods of avoiding or eliminating them. We want to bring out some of our operating experiences for our own information and for the benefit of AMERICAN FOUNDRYMAN readers.

C. R. McGrail: Recently we have been confronted with considerable scabbing which occurs on the drag side of large, flat, gray iron castings. Our sand is synthetic, consisting of silica sand and bentonite, and I believe the scabbing is due to the ramming method.

Malcolm J. Henley: We make quite a few stove tops, and when we get into scabs the first thing we do is measure the mold hardness over a uniform section. We usually find that ramming is our trouble. However, we have found that where we thought our sand was up to specification and our mold hardness correct, the temperature and speed of pouring had something to do with the scabbing.

P. B. Croom: Do you have scabbing when your molds are soft, hard, or non-uniform?

C. R. McGrail: Most generally when the molds are hard. I think the method of pouring has a decided effect, but when your gating system is constant and scabbing develops, then it must be due to some other condition, either the sand or the ramming.

P. B. Croom: How do you define a scab? How do you recognize it on a finished casting?

C. R. McGrail: A scab is a mass of fused iron and sand that has a definite line of demarcation between the scab and main body of the casting. There is generally also an undercut in the main surface of the casting. It appears as a projection on the casting.

Malcolm J. Henley: There may be a cavity in the casting as well. Do you think a buckle and a scab are the same?

C. R. McGrail: I feel that a buckle is just a degree of scabbing. In fact, in a recent case, the first thing we did was make an addition of wood flour to our sand. While the wood flour in most cases overcomes scabbing, I believe that we could have used the same sand with proper ramming.

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John G. Collier: I have always felt that mold conditions producing scabs are quite different from those causing buckles, both however, resulting from the thermal instability of the sand mold. A wood flour addition would probably help either case, by reducing the hot strength and the mold hardness. The same result could be accomplished by using a sand with less fines, less water, and the proper amount of bond.

Marvin W. Williams: It seems from this discussion so far that I have heard three things which may lead to scabbing. First, sand condition, second, mold hardness, and third, rate of pouring. I would like to know what experience any of you have had with the rate of pouring as a direct cause of scabbing. And also if there are factors, other than those three, which might cause scabbing?

Walter J. Temple: When we have scabbing in steel, we think part of our trouble might be in our washed silica sand. We know it is clean, but maybe the back-up sand does not allow the gases to escape.

C. R. McGrail: This is interesting inasmuch as our facilities do not permit us to properly process our synthetic sand and we have to depend on the proper processing of the facing sand. Our back-up sand, which is the same type of material but not properly bonded, is not in too good condition.

Marvin W. Williams: Mr. Bird, we have discussed

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with these steel men and iron men the question of scabbing. Do you have a similar problem in nonferrous castings?

John M. Bird: We have found it possible to use the same sand over and over again. But we have found also that no matter what you add to the sand, you do not get the same results as with the newer sand. You can lift a "belly" and have a clean lift, but your bad sand shows shifts, swells, scabs, and buckling. The used sand seems to mold alright but it does not seem to hold in the mold at all. Adding new sand to the old heap produces good results for a day or two, perhaps a week. If you replace the whole heap with new sand, your trouble is gone for a month or more, depending on how much you use your sand. This goes for synthetic or naturally bonded sands.

Marvin W. Williams: Do you find most of your defects in the drag?

John M. Bird: In the majority of cases. The only remedy was to add new sand to the old heap.

John G. Collier: Mr. McGrail, can you consistently create a scab?

C. R. McGrail: If you give a job to a certain molder, yes.

Marvin W. Williams: Isn't that mold hardness?

C. R. McGrail: I am inclined to believe so. That is one factor involving the personal element at the molding stage. Moisture can also cause scabs.

Walter J. Temple: If you are having scabs caused by poor bond, you can add wood flour or dextrine.

John M. Bird: You can do that, but in the first heat the sand goes through, you are right back where you started.

W. H. Lyne: Isn't Mr. Bird talking about natural sand and Mr. McGrail talking about synthetic sand?

C. R. McGrail: Our standard practice is to use about one half new sand and one half old sand for facing.

John M. Bird: Have you ever taken into consideration the riddle or the screening process?

C. R. McGrail: Not definitely, but we assume that the molder is using the same size riddle in all cases. I find that on an old heap of sand, screening, especially by an electric or mechanical riddle, is definitely a good thing.

M. J. Henley: Mr. Williams asked about pouring and the effect it has on scabs. Stove tops are susceptible to all the defects including scabbing, and the rat tails which you find in the thicker sections. We make a pretty complete sand test, and we have, as far as we know, the same sand from day to day. Our mold hardness is comparatively constant, but sometimes we encounter rat tails or buckles and the only way to stop them is to change our gating. When too much iron enters a flat section at one place and expansion of the sand becomes great you will get buckles.

Now I would like to bring up a different type of scab. This results when you close the mold and the mold sweats. If the mold stands too long, and if you use hot sand and a cold core the defect that may result is a scab.

C. R. McGrail: Is that type of scab made up of iron and sand without any definite line of cleavage between the main body of the scab and the defects?

Walter J. Temple: Yes, there is cleavage. It does not go into the casting like a buckle but it is definitely a burn-in rather than a scab. A scab such as Mr. Henley speaks of leads back to too much moisture in

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the sand. I don't think it would cause the burn-in, but would be an expansion type scab.

John M. Bird: The back-up sand weakens your facing sand. Probably that expansion or contraction in the mold goes down 2 in. on a casting weighing 10 or 12 lb.

John G. Collier: I don't think the back-up sand has much effect on the facing because as the mold is poured the greatest temperature change takes place in the first quarter to half inch of the mold cavity face. If the proper sand conditions exist there the back-up sand is not critical.

W. H. Lyne: I think Mr. Collier's observation has been verified by the shell molding process. In this, a thin layer of sand with an organic bond produces an excellent mold and it does not require a full $\frac{1}{16}$ in. of sand. This mold facing could be backed up with cinders. In the shell molding process, copper or steel shot is used.

Marvin W. Williams: Is it true that another factor in the sand that enters into the formation of scabs on the castings is the permeability of both the facing sand and the back-up sand?

John M. Bird: Surely. The rate at which gases, evolving from the mold as the casting is poured, will move away from the casting is closely related to the permeability of the sand.

C. R. McGrail: I agree that the permeability probably influences the formation of a scab, but I cannot agree that it is the primary cause of scabbing. I think

all foundries have had the same experience that we have had, wherein they have used the same sands of the same permeability, and have made castings with and without scabbing. I think the permeability is probably the one property of the sand that is fairly constant, more so than mold hardness or moisture or composition, such as bond or wood flour or other ingredients.

W. H. Lyne: Do you feel that the cure could be found at the molding floor, rather than at the sand mill?

C. R. McGrail: Yes, and I think the control of scabbing can be accomplished more on the molding floor than at the sand mixer.

P. B. Croom: That is a significant statement, inasmuch as we have men here who have excellent sand conditioning equipment and some who don't have elaborate facilities. But all have scabbing from time to time.

Marvin W. Williams: In other words, all of the factors we have discussed work together in the formation of a scab.

C. R. McGrail: Yes, I think that is true. In mechanical molding we tend to check scabbing by changing our sand mixture, because we assume that the degree of ramming is fairly constant. With hand ramming, we have no control over the degree of ramming by the molder, so we try to furnish a constant type of sand to the molder, and if a scab occurs we blame it on the ramming.

Marvin W. Williams: We have had quite a discussion on scabbing. What other defect seems to occur in most shops?

Walter J. Temple: I think we have discussed the main one. Second, I would say, is pin holes.

Marvin W. Williams: What in your opinion causes pin holes in castings?

Walter J. Temple: Many things—off-analysis, a wet ladle, or a wet mold.

M. J. Henley: Do you mean oxidized metal?

W. H. Lyne: It may be spoken of as wild heat.

Marvin W. Williams: May I give an illustration of what can happen with respect to pin hole porosity in melting and pouring of steel? For some time we had difficulty with the percentage of moisture in the sand. One day we melted the steel and on pouring it appeared to be good steel. The fracture test looked good and the carbon was OK. We poured that steel into one ladle and into both green sand and dry sand molds. Some three or four minutes after the metal was poured into the green sand molds, it went wild and made a nice toadstool effect on the top of the riser. The metal poured in the dry sand molds lay quiet and had the normal shrinkage. When those molds were opened, all of the green sand castings were literally covered with pin holes. The castings produced from the dry sand molds were solid.

John G. Collier: Was the pin hole porosity throughout the body of the castings, just through the thick sections, or confined to the ends or the outer portions?

Marvin W. Williams: To the best of my knowledge it covered the entire surface of those castings. I don't recall that we sectioned any to see the inside.

W. H. Lyne: You will not find pin holes in sections that solidify very fast. They will usually be found in the thicker sections and they occur there because the gas will migrate to the heavier sections as solidification reactions take place.

Marvin W. Williams: A further study showed that the chemistry of the steel was satisfactory. So from an analysis of what happened, we can assume that the mold conditions were very poor in the green sand molds. The same metal poured into dry sand molds was good.

Walter J. Temple: If the moisture content of a green sand mold is around 3½ per cent and your metal is all right from the furnace, and you handle it in a dry ladle, the moisture will not make it wild. But if your metal is so near the borderline between good and bad that 3 or 3½ per cent moisture may or may not put it on the wild side, pouring in dry sand will result in a good casting.

Marvin W. Williams: I'll agree with you, Mr. Temple, for in this particular case, we found we were running about 7 per cent moisture. But good metal could produce poor castings if poured into bad molds.

John M. Bird: Do you use a different sand for dry molds?

Marvin W. Williams: Yes, we usually use a different type of sand mixture in dry sand molds than in green sand molds.

John M. Bird: Considering the permeability alone, you can pour as high as 7 per cent moisture, if the permeability is high enough.

Marvin W. Williams: I think that your sand condition would be different for non-ferrous than it would be for steel.

John G. Collier: I cannot visualize the moisture from the mold gassing the whole body of the casting uniformly. Seems to me that with permeability low and moisture high and metal "on the fence" the gas is not being pushed into the metal but is already there and not allowed to come out except as porosity.

Marvin W. Williams: I think that with the very high moisture content that we had on the molds in question, a tremendous volume of gas was created; even though the permeability of the sand mixture was proper, it was just too much gas to get out in the period of time in which it should have escaped. The gas would show up more prominently if it would blow such as you are suggesting.

W. H. Lyne: You may be asking for a discussion of causes of porosity due to mold conditions. Mr. McGrail, what is your opinion on that?

C. R. McGrail: I believe that gassy conditions of por-

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osity in a casting can come from the mold, in which case the evolution of the gas from the excess moisture can cause a mushrooming of the gate or riser, without a definite blowing of the metal out of the mold.

I also think that mushrooming can be caused by metal oxidation, for example, in steel or non-ferrous metal, where you have gas entrapped in the metal. I don't believe that excessive moisture in the sand will cause a violent blowing of the metal in the mold in all cases.

John G. Collier: If you tried to create that condition, taking perfect metal and ideal conditions up to the mold, you would find it very difficult to produce risers that mushroom.

C. R. McGrail: I have seen it happen in cases of iron, but I don't believe it is possible to oxidize cast iron or any material that has so much carbon, silicon, and manganese. I have seen castings made from the same ladle, some showing mushroom effects and others

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with a normal pattern of solidificaton. We knew the moisture content of the molds that mushroomed was high.

John G. Collier: I cannot see that moisture in the mold would do more than create a pressure that would keep the gas in the metal from coming out through the mold without showing some other defect. Evidently the casting has a good outside appearance. If it has pin holes you cannot see them on the outside.

C. R. McGrail: Oh yes you can.

Walter J. Temple: There is a difference in pin holes which shows up in vents and risers on molds. Where you have a high moisture content, you will show surface porosity. You might have a riser level off flat where it should pipe. If you have a flange with a fillet, you might find porosity around the fillet with small pin holes on the surface. If you have a riser on the flange and cut into it, you'll find pin holes there, if you have gassy metal. If you don't find gas porosity there but around the fillet, that is porosity from wet sand.

John G. Collier: Seems to me that if you can see porosity in the skin of the casting, without destructive examination, it should be obvious it comes from a mold and not the metal.

Walter J. Temple: Not always. If you have a wild heat, you might show more porosity around the fillet. Wherever you have a mass of metal cooling last you may have porosity.

John G. Collier: As temperature goes up all metals hold more gases in solution. When the temperature goes down, the gas collects in little bubbles as it comes out of solution.

John M. Bird: That is why when your metal gases, you generally find porosity in the outside portion of the casting, which solidifies first. Sometimes, it will look good until you section it. Then you'll find that the inside of the metal that solidifies last is solid and around the outside of the casting you will find a degree of porosity.

John G. Collier: That is the reason I asked whether the porosity could be seen from the outside or not. If the casting were pitted from the outside the first place I would look would be the mold. If I found porosity under the skin, I'd look at my metal because I've found that you can take many liberties with your mold and still get a good casting—provided you have good metal going into it.

W. H. Lyne: I think you are quite right and I believe that pin-hole formation and gas porosity are essentially a function of gas coming out of solution. For me to try to visualize moisture in a mold blowing itself into a casting as a bunch of pinholes is just out of reason. But a high moisture content will make hydrogen gas available to be dissolved in the steel, and that, as you know, will then follow the path of least resistance and migrate to the section that solidifies last—such as a hot spot like Mr. Temple's fillet—and attempt to escape. If it gets out, you have a pin hole. It is a function of some of the gas being dissolved, then being forced out of solution.

John M. Bird: Mr. Temple, referring to your comments about metal being on the border line between good and bad do you think that pouring a few degrees low is liable to result in a bad casting? Do you find more porosity on a lower or higher temperature?

Walter J. Temple: It is the oxidized condition of the metal that counts. I have not noticed whether pouring temperature influences porosity.

Marvin W. Williams: We believe, in steel, that there is a rather wide range in which metal can come from the furnace and still be considered good metal. If the metal is almost bad, then poor mold conditions would be enough to kick it over and create a bad casting.

John M. Bird: In making bronze bushings, we found that the lower the temperature, the bigger the holes you will have in them.

W. H. Lyne: What temperature are you speaking of?

John M. Bird: 1950 F. Pouring at 2100 or 2000 F you cease to have pin holes. You have egg-size holes when pouring at 1800 F. The gases accumulate in big spots, rather than in pin holes.

John G. Collier: If you pour at higher temperatures you get less porosity?

John M. Bird: Yes. The metal should be brought up to as high a temperature as it will stand without burning.

John G. Collier: Allowing the metal to degas itself after it gets into the mold by pouring hot requires proper sand. We have apparatus to test the sand, but nobody has developed a simple test for gas content of liquid metal.

Walter J. Temple: One time we were working with 2500 lb of steel and we poured half of the heat in green and dry sand molds and it made no difference

in the castings. The first half of the heat was all right but when the ladle was half empty it started to boil. We poured a mold or two more and the boiling got worse, and metal finally started to fly out of the ladle. Castings poured after we noticed the boiling in the ladle were no good.

M. J. Henley: Wet ladle! As you lowered the metal, the pressure was less and the gas or steam was able to come back into the metal.

John M. Bird: If you did put the metal in the ladle and the steam was boiling it over, it would not kick back out of the molds would it?

John G. Collier: Yes, it might. You can take liberties with the mold but few with the metal.

M. J. Henley: I suppose all foundrymen have some kind of trouble, at times, with hot cracks or tears.

Marvin W. Williams: What do you think causes them?

M. J. Henley: Many things. One is the sand condition, a big contributor to hot tears. Another is oxidized metal. If you analyze your slag from time to time, you will find a tremendous difference in the manganese oxide in the slag of different heats, and I know that you people in steel find the same thing.

Marvin W. Williams: You are speaking of hot tears and not hot cracks. In connection with hot tears we have a pattern man here. Mr. Croom, what steps do you take in connection with construction of a pattern to eliminate hot tears? What is the foundryman trying to do to eliminate hot tears in castings or is there any connection between the construction of the pattern and the hot tear?

P. B. Croom: In all my experience, a foundryman has never mentioned hot tears in connection with the construction or design of a pattern. We sometimes put ribs on the pattern to prevent their cracking, but I don't think that would be called a hot tear.

Marvin W. Williams: What is the rib for?

P. B. Croom: To prevent cracking during cooling.

W. H. Lyne: Gentlemen, let's define what we are talking about.

M. J. Henley: I think a hot crack happens after the metal solidifies and the hot tear occurs during solidification. A hot tear always has a ragged surface showing it cracked at a very high temperature and during solidification, when the metal had low strength. A hot crack occurs after solidification and you get a smooth crack, but an oxidized or blue surface in the case of ferrous metals. A hot crack may be prevented by normalizing, while a hot tear must be prevented by careful conditioning of the sand, correct ramming, or even better, by proper casting design.

Marvin W. Williams: You certainly can prevent a hot crack by normalizing, but you cannot prevent a hot tear.

W. H. Lyne: What we are saying is that the hot tear occurs in a section which is not entirely solid, but is pulled apart by two adjacent solidifying sections, whereas the hot crack occurs in a section which is already solid.

Walter J. Temple: When steel goes through about 2500 or 2600 F, right at the point of solidification, it has no tensile strength. A 1-in. section at a given time might have no tensile strength, while a 3/16 or 1/4 in. fin or rib on the same casting would be solid and strong. The rib does two things: it takes off heat like a fin on an air-cooled engine, and it holds the casting together while the heavier section is solidifying.

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Marvin W. Williams: What other methods do we have to eliminate hot tears?

Walter J. Temple: Chills.

M. J. Henley: Proper conditioning and ramming of sand.

C. R. McGrail: I still have not heard any reason for the hot tears.

M. J. Henley: Segregation, possibly. From the practical standpoint, if one section solidifies first, you get shrinkage which needs something to feed from. It draws on the heavy section next to it. That is one type of tear. It almost goes back to internal shrinkage. If you had a feeder to pull from that would probably help the condition, or you may use a chill. The other form of hot tear is caused by the sand being too strong while the metal is solidifying. It still has to do with solidification, temperature, and shrinkage.

C. R. McGrail: Then according to your definition a hot tear is a form of shrinkage—internal shrinkage?

Walter J. Temple: There is a difference between a hot tear and tear or shrinkage crack caused by insufficient feed metal. A riser next to the hot tear may help or may not help. If it is a hot tear, the riser is going to help tear it more. If it is a shrinkage crack, the riser does not supply sufficient metal and the crack is going to be larger.

M. J. Henley: High core density or mold density is another cause of hot tears.

Marvin W. Williams: I want to go back to the oxidation of the metal. Certain heats are definitely prone to hot cracking.

John M. Bird: What is the explanation for a series of castings in which the first one tears and the next one does not, the next three do, and the next one doesn't?

M. J. Henley: Pouring temperature has something to do with it. It might be the mold condition changing.

Walter J. Temple: Could be the cores. Some of them may collapse and some of them may not. There can be a difference in core density and it is simple to check. All you have to do is to weigh the cores.

Marvin W. Williams: Aluminum is much lower in strength, even when it is cold, than steel. As a result you certainly have very low strength in the mold, when the metal is in the molten or mushy state. You probably use a lower strength sand than we do in steel to offset that condition, but with a high strength

sand you would have many hot tears in aluminum. Is that not true?

John G. Collier: Very much so. We have to use a much softer core in aluminum than in steel or even the red metals. One reason is to avoid trouble with hot tears, and the other is economy. If you don't have to have a high strength core you don't have to put much bond into it, and that reduces your cost.

M. J. Henley: The pouring temperature has a lot to do with it.

Marvin W. Williams: I was trying to make this point, that aluminum has lower strength than the red metals in the molten state.

John G. Collier: I don't think there is much difference. I don't think any of them, at certain temperatures, have tensile strength.

W. H. Lyne: All of them have some strength. The question I would like to have answered on tears and cracks is whether they are a function of the shrinkage

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from the liquid to the solid, or whether you were talking about the linear shrinkage or contraction.

C. R. McGrail: I cannot believe that the linear shrinkage is going to be sufficient at the temperature at which the hot tears occur to create a hot tear from the resistance of the mold. I do agree that the hot crack can be caused by contraction or linear shrinkage. In my experience, hot tears occur at a point where the metal is subject to internal shrinkage and never at a point where there is no shrinkage problem. It seems logical that a casting subject to hot tears, properly fed from an internal shrinkage standpoint, should be a satisfactory casting regardless of the condition of the mold.

The mold condition might affect the internal shrinkage but certainly not the linear contraction of the mold at those temperatures. That metal is not starting to contract at those temperatures.

W. H. Lyne: It is the volume change from liquid to solid that in my opinion causes a hot tear.

John G. Collier: It seems to me that all hot tears would be eliminated on that score, if you could get solidification and shrinkage to take place at one time.

John M. Bird: Would you call this shrinkage? We have had experience with wheel castings which have come out of the mold all right, but have popped open by the hundreds in the warehouse.

Walter J. Temple: Some sort of heat treatment would relieve that.

John M. Bird: We changed the design. There were castings that we even tried to break with a hammer and couldn't, and they were made out of aluminum.

M. J. Henley: I have seen castings that were made one day and by the next day they would pop open and pieces would fly as far as 15 ft due to the condition you are talking about.

P. B. Croom: That was due to internal stress.

Marvin W. Williams: Mr. Bird, is it not true that aluminum goes through an aging process?

John M. Bird: Definitely. I think that most metals go through certain changes that cause internal stresses, some of which are relieved by the design of the casting.

Marvin W. Williams: I can certainly see no tremendous stress being relieved by design.

John M. Bird: An architectural draftsman made the design. When he called me about the job, I suggested the change and, of course, insulted the engineer. We melted the castings over and they were bad. We changed the metal and put 99 per cent pure aluminum in them. We poured off the heat at noon and we did not dump it until after lunch. Then we took the copes off and the castings had broken in two places, and in the spokes and a portion of the rim there were two large cracks. Yet you could not break the castings with a sledge hammer.

I inspected the castings in the warehouse and found some had cracked. After we changed the pattern and made the spokes S-shaped there was no way of breaking those wheels. Changing the design seemed to be the way to solve the problem.

John G. Collier: To come back to our first topic, is a metal penetration or burn-in the same thing as scabbing? It does not have the same appearance.

Marvin W. Williams: Metal penetration occurs when metal actually goes into the pores of the sand.

Walter J. Temple: Speaking of steel, silica flour will stop penetration. Raising the refractoriness of the sand does not help because of mold expansion.

John G. Collier: One type of penetration I have in mind occurs in casting leaded red metals and is actually a problem of whether the lead is held in the alloy until it solidifies. In bushing castings, the core may be so impregnated with lead that the casting has to be scrapped.

John M. Bird: Does it occur on the bottom of the casting?

John G. Collier: It will be in the lower sections if it is not serious and will be all the way through, if serious.

C. R. McGrail: You can mix a batch of core sand with silica flour, bentonite, and cereal binder way beyond what is normally used and still have a burn-in condition.

M. J. Henley: It may be a chemical reaction. In 4 per cent chromium steel the chromic oxide just eats up the sand. The only thing you can do is put in boric acid or sulphur.

John G. Collier: I understand that iron oxide is good.

W. H. Lyne: I don't know but I wonder if it would be practical to use it in non-ferrous sand.

John G. Collier: We think that core collapsibility is the principal factor in the situation I mentioned, but not the answer to the whole problem.

W. H. Lyne: Can you pour at a lower temperature?

John G. Collier: We poured at about 1950 F. That's pretty low.

C. R. McGrail: I think we have run into the same condition where we pour identical castings out of a leaded red brass, 85 three 5's for example, and have burn-in on the core. The same casting with the same type of core sand poured in bronze gives no burn-in problem. We have overcome it to a large degree by changing the core wash, using a different type of core wash, or making sure we had a good heavy core wash with 85 three 5's, and it has seemed to help.

Marvin W. Williams: What type of core wash do you use?

C. R. McGrail: We tried a proprietary wash (basically zirconite) and a plumbago wash and gave the cores two or three coatings and a rub down.

Marvin W. Williams: Zirconite washes seem to penetrate the sand more and we use them more than the plumbago type of wash.

John M. Bird: Some of the non-ferrous foundries are using the same facing that the steel foundries are using on account of that condition. We are using silica flour.

John G. Collier: When the core collapses too soon, you can do everything but put a metal coating around it and you will still get penetration.

C. R. McGrail: Under those conditions you would get veining of the core.

Walter J. Temple: Have either of you tried iron oxide to correct this condition?

John M. Bird: No, I have not.

John G. Collier: In the pin test, iron oxide in the sand mix stopped steel penetration to a marked degree even when the metal was poured at high temperature.

***John G. Collier,** foundry superintendent, Garrott Brass & Machine Co., Houston, Texas, had 4 years foundry and machine shop work with his present company before entering Texas A & M College, Mech. Engr., in 1938. Entering the Army Air Corps in 1941, he served in the Pacific as Engineering Officer until 1946, then assuming his present position.*

W. H. Lyne: You might try some of the ceramic washes for your lower melting metals. Off hand, I would think that iron oxide and silica flour would be more refractory than necessary.

John M. Bird: I have used silica flour and graphite side by side and the silica wash does a lot better job than the graphite under all conditions. We have made castings that we were not able to hold with graphite at all, and using the same cores in the same molds with the same gates, used a silica flour wash to get good results. Even on aluminum and brass it makes a smoother job.

Marvin W. Williams: You mentioned that you used two or three coats of wash on your cores. Do you dry them before each coating?

John M. Bird: We spray them hot.

Au Revoir

The following excerpts from the editorial in the February 15, 1951, issue of Foundry Trade Journal *(London) edited by V. C. Faulkner, are reprinted without comment.*

THIS WEEK the British iron and steel industry officially becomes a State monopoly. This is a matter of great moment for ferrous foundry interests because their annual turnover follows the same pattern as iron and steel and State monopolies have so far not produced any new record high outputs. Thus, in general terms, a recession of trade can be anticipated despite the rearmament program. Free enterprise loses about 18 foundries—it is difficult to say just how many, as some of the firms expropriated operate a number of plants. . . . . The steel castings industry loses 25 per cent of its capacity to the State.

We fail to see what benefits can accrue from the creation of an iron and steel monopoly. It will not produce an extra ton of pig iron or ingots; no price reduction is in sight and labor relations cannot very well be improved as harmony has reigned within the industry for many decades. The change-over will not bring in a single dollar nor will it make for easier sales in foreign markets. The competition between the State works and those left to private enterprise will create all sorts of difficulties and potential unpleasantness. It is reasonable to forecast that the number of non-producers will be increased, so producers will have to work harder to keep somebody else's family.

The new conditions mean that one more raw material—pig iron—will be produced and sold by the State and should it follow the same path as fuel and electricity, supply and transport, more chaos can be expected. All the present economic difficulties are not due to the aftermath of war—as Sir Claude D. Gibb recently said to the Manchester Association of Engineers, leaving his audience to draw their own conclusions. However, the country can rely on the foundry industry, both the State monopoly and free enterprise sections, to carry on intelligently to service all other industries with their essential requirements in cast products.

INDUSTRIAL ENGINEER in

This paper briefly discusses the part which an industrial engineer can play in the foundry industry and shows what his training and experience have been and how they can best be utilized. This is one of a series of papers presented at a Foundry Educational Foundation meeting February 15 and 16. Practical, as well as theoretical training is received by most college students now entering the foundry industry through summer work in industrial foundries or cooperative courses.

PRODUCTION OF CASTINGS requires the integration of the efforts of human workers and the operation of machines. Skill and knowledge conquer matter; insight and wisdom conquer men.[1] Matter and men are the subjects which the industrial engineer studies during his five years as an undergraduate at Ohio State University.

Insight and wisdom in an engineer indicates that he has become, for one thing, a discriminating individual. In addition to the customary engineering background which confers upon graduating engineers the usual skill and knowledge, industrial engineering attempts to point the way to insight and wisdom so necessary for a person who expects to become part of supervision and management.

Foundry Under Industrial Engineering

Therefore, we believe it is fortunate that foundry studies at Ohio State University are associated with the Department of Industrial Engineering. Our industrial engineers receive the same basic skill-and-knowledge courses as do all other branches of engineering. The foundry courses are built into the OSU foundry option in industrial engineering which has been previously described.[2,3] A student must be credited with 292 hours in order to graduate; 30 hours or about 10 per cent of the course work is devoted entirely to foundry science. Each undergraduate student has 18 credit hours devoted to technical elective courses. Many select such courses from the regular industrial engineering curriculum.

All engineering students have the same mathematics, chemistry, and physics background. Industrial engineering and foundry option students are required to take an additional course in statistical mathematics which is a prerequisite for the course in industrial quality control, a course concerned with *statistical* quality control. All industrial engineering and foundry option students take the courses in metal fabrication—machine tool practice, heat treating and welding, and foundry science.

Motion analysis and time study, safety engineering, labor relations, production control, and management of men in engineering industries are courses common to industrial engineering and foundry option students. Regular industrial engineering students take courses in tool engineering, and plant design and layout. The latter courses are available as technical electives for foundry option students.

Required for foundry option students in other departments are two courses in metallurgical engineering and one course in ceramic engineering. Other courses in these departments are available as technical electives. Our students are required to devote 15 hours to non-technical electives in addition to the required non-technical courses specified by the curriculum. As adviser to all foundry option students, the writer generally suggests that the non-technical electives be chosen from the fields of logic, philosophy, speech, geography, music, etc.

At Ohio State University, the introductory foundry science courses covers the manufacture of castings. Our time breakdown for this course is:

DIVISION	TIME, %
Patternmaking and Pattern Rigging	5
Foundry Materials	25
Molding and Pouring	15
Material Handling	30
Cleaning	5
Receiving, Inspection, Shipping	5
Melting	15

These divisions require skill and knowledge. The divisions of castings manufacture which require insight and wisdom include management, supervision, motion analysis and time study, labor relations, and production control.

Design for casting manufacture is a complicated problem. We believe any design should consider in addition to the usual strength and service factors, such matters as safe practices, economy of motion by operator or service personnel, and whether or not the design lends itself to incorporation in an efficient production control system.

Industrial engineering and foundry option students take one course in accounting and one course in factory cost accounting so that whenever they enter supervision, they will understand cost control. As engineers, they can serve as liaison personnel between production and the accounting offices.

A brief outline of the OSU foundry science courses indicates the background obtained by the students.

Industrial Engineering 405. Required for all industrial, mechanical, and welding engineers. (1) purpose of course, foundry history, laboratory procedures, grading system and tour of foundry laboratory; (2) advantages and disadvantages of fabrication by the casting method, and patterns; (3) molding principles and methods; (4) inorganic molding materials; (5) tests on sand mixtures, and organic bonding agents; (6) gating and risering; (7) brief survey of gray iron, white iron, malleable iron, and steel, and cupola melting; (8) cupola melting continued, and melting of white iron and annealing; (9) steel melting; (10) non-ferrous melting, and properties of alloys.

The laboratory procedure for this course is set up to reproduce as well as possible the simultaneous operations of molding, core making, melting, pouring, cleaning, and inspection of commercial foundries.

Castings are produced for machine shop exercises, for the Department of Mechanics, and for the University Service Department. Each member of the class

the FOUNDRY

Douglas C. Williams
Associate Professor
Industrial Engineering
Ohio State University

rotates on assignments so that he takes part in floor molding (loose and gated patterns), bench molding (match plates, cope and drag mounts), machine molding (match plates, cope and drag mounts), core making (hand and machine), sand mixing, melting and pouring of cupola iron, brass and aluminum alloys, shakeout, grinding, and chipping.

The rest of the foundry courses do not have a hard and fast outline because the subject matter is constantly changing and class discussions preclude a fixed schedule. Accordingly, in the following courses only general subjects are listed. All are required for foundry option students and are elective for students who have the proper prerequisites. These courses are:

Industrial Engineering 505. Lectures cover sand, clay minerals, water, and abrasives. Calcination, thixotropy, and the mechanism of bonding are discussed. The proper order of adding ingredients to a sand mixture is given with reasons for the procedure. Students write several reports on assigned topics. No text is available.

Industrial Engineering 606. Machine and hand methods for the production of molds and cores are discussed with reference to the function of molding. Principles of soil mechanics are introduced as they apply to molding and core making. The advantages and disadvantages of green, skin-drying, and baked sand molds are discussed.

When the quarter is half completed the course material is changed to gating and risering. Treatment is both fundamental and mathematical. Dwyer's *Gates and Risers* is used as a reference and additional assignments are given for reports.

Industrial Engineering 607. This is a continuation of IE 505. Subject matter concerns fundamentals of organic bonding agents and how such fundamentals apply to the foundry industry. No text is available. The laboratory exercises are concerned with sand testing at room, baking, and elevated temperatures. Laboratory reports and reports on assigned topics.

Industrial Engineering 716. This course uses all the subject material in the previous courses in relation to difficulties encountered in manufacturing castings. The various types of casting defects are discussed. Several reports are required. The A.F.S. Analysis of Casting Defects is used as an outline.

Industrial Engineering 717. Deals with the fundamentals of centrifugal, die, investment, permanent, slush, and vacuum casting methods. When known, a mathematical treatment is applied to the methods. Reports on assigned topics are required. No text is available.

Industrial Engineering 718. The course opens with a discussion of heat treating ovens, Then follows material on the heat treatment of all alloys which are altered by such procedure. At present the laboratory exercises consist of visits to various foundries where heat treating operations are in progress. Reports on each visit are required as are reports on assigned topics. No text is available.

Richard Shurmer, sand mixing supervisor, has been with Ferro Foundry & Machine, Cleveland, since graduation from Ohio State University in June 1947.

Industrial Engineering 719. Deals with melting. Time given to each alloy is related to its proportion of the total weight of castings produced industrially. Discussions include producing melts of the best "melt quality." The A.F.S. Handbook of Cupola Operations is used as a text for part of the course.

Students in this course carry out all details of charging melting, and tapping the cupola for the heats at which introductory foundry students pour.

Where can the graduate industrial engineer fit into foundry operation? The Foundry Educational Foundation has prepared a list entitled Functions of Company Divisions Where Engineering Ability Can Be Applied.[4] Parts of this are reproduced below to show how the industrial engineer fits into the foundry industry. The specific course titles show how the industrial engineer has been especially trained for the field under consideration. Details on course content can be found in the Ohio State University catalogue.

Cast Products. Use of Castings (application)—in preparation for this field students study—tool engineering, plant equipment and design, product engineering, and engineering economy. Casting Design—same as above plus two courses in machine design. New Cast Products—same as Use of Castings and Casting Design. Competitive Analysis—engineering economy.

Casting Sales and Markets. Sales Management—personnel management in engineering industries, and problems in sales engineering. Advertising and Promo-

TION—no direct course but can be studied as an elective in Department of Commerce. MARKET ANALYSIS—plant equipment and design; commerce courses. SALES ENGINEERING—problems in sales engineering. CUSTOMER SERVICE—all industrial engineering courses have a bearing on service where insight and wisdom are as important as skill and knowledge. BRANCH MANAGEMENT—personnel management in engineering industries, problems in sales engineering, and production control research. FOREIGN SALES—same as Advertising and Promotion and Branch Management.

Cost Control. FINANCING—corporate organization and control. COSTS and ACCOUNTING—two separate operations. For Accounting, industrial engineers take two accounting courses. For Costs, they study production control charts, methods analysis, work measurements and standards, industrial quality control, tool engineering, plant equipment and design, production engineering, engineering economy, production control, safety engineering, and special problems in: personnel, time and motion study methods and evaluation, production control and economy, quality control, safety engineering, plant design, production engineering. OFFICE MANAGEMENT—methods analysis, work measurements and standards, methods engineering, and personnel management. STATISTICS—statistical methods in engineering, production control charts, work measurements and standards, and industrial quality control.

Castings Manufacture. PRODUCTION DESIGN AND PLANNING—tool engineering, plant equipment and design, production engineering, engineering economy, production control, safety engineering, and problems in production engineering. STANDARDS AND METHODS—production control charts, methods analysis, work measurements and standards, and methods engineering. TOOLING AND RIGGING—foundry molding methods, tool engineering, and foundry casting methods. MAINTENANCE—all industrial engineering, mechanical engineering, electrical, and mechanics courses.

Supervision—labor problems, labor relations, personnel research in engineering industries, and personnel management. INSPECTION—strength of materials, metallography, and physical metallurgy of iron and steel. QUALITY CONTROL—statistical methods in engineering, production control charts, industrial quality control, and special problems in industrial engineering. STORES AND YARD—plant equipment and design, and engineering economy. PLANT TRANSPORTATION—plant equipment and design, and engineering economy. SHIPPING—plant equipment and design. STOCKROOM—plant equipment and design.

Purchasing. SOURCE OF MATERIAL OR PARTS—foundry molding materials, foundry materials, production control, industrial quality control, and production control research. INTERVIEWING SCHEDULING—production control. PURCHASE ORDERS AND CONTRACTS—corporate organization and control. CLEARANCE OF DELIVERED ITEMS—production control.

Personnel. EMPLOYMENT—psychological problems in engineering personnel research in engineering industries, and personnel management. EMPLOYEE SERVICE ACTIVITIES—personnel management. SAFETY—safety engineering, and safety engineering research. LABOR RELATIONS—labor problems, personnel management, labor relations, and personnel research in engineering industries. PUBLIC AND EMPLOYEE RELATIONS—production control, plant equipment and design, and personnel research in engineering industries.

Two graduates of Industrial Engineering have presented papers or had an article published indicating the relationship of industrial engineering to the foundry industry. Harry Placke, G.H.R. Foundry Div., Dayton Malleable Iron Co., Dayton, Ohio has presented two papers entitled *"Application of Quality Control in a Foundry."* One was given at the 1950 Ohio Regional Foundry Conference, the other before the Columbus (Ohio) Chapter of the American Society of Quality Control Engineers. John W. Anibal, Chevrolet Gray Iron Foundry, General Motors Corp., Saginaw, Mich., has described[5] the engineering of the overhead sand preparation and distribution system for the foundry laboratory at Ohio State University.

References

1. L. C. Monin, "Liberalizing Studies in the Curriculum of Engineering Courses," *McGraw-Hill Book Notes*, Oct. 1924, p. 3.
2. P. N. Lehoczky, "How Foundrymen Can Activate College Foundry Courses," AMERICAN FOUNDRYMAN, vol. 16, no. 2, August 1949, pp. 60-61.
3. D. C. Williams, "Foundry Option at Ohio State University," AMERICAN FOUNDRYMAN, vol. 15, no. 5, May 1949, pp. 106-108.
4. Minutes of the Foundry Educational Foundation TAC-UAC Meeting, February 16-17, 1950, p. 17.
5. John W. Anibal, "Mechanize Sand Conditioning and Distribution System at Ohio State," AMERICAN FOUNDRYMAN, vol. 17, no. 5, May 1950, pp. 85-86.

Develop New Calibration Procedure For Determining Test Sieve Openings

SIMPLE, RAPID PROCEDURE for determining the effective opening size of testing sieves, has been developed by V. R. Deitz and F. G. Carpenter of the National Bureau of Standards, Washington, D. C.

Employing calibrated glass spheres of graduated size, the new method determines the effective opening of a sieve, i.e., the opening corresponding to the largest size of calibrated spheres that will just pass the sieve. With this method, sieve analyses made at different laboratories with varying sets of sieves, can now be reported with reference to the same openings, and discrepancies which occur under existing methods can be greatly reduced.

Evaluation of the effective opening of a sieve with the glass spheres is easily accomplished by sieving a calibrated sample of the spheres in exactly the same manner as in the usual sieve analysis. This sample contains a continuous distribution of sphere sizes. The weight percent passing the sieve is evaluated, and the effective opening of the sieve can then be read directly from a calibration curve supplied with the sample. Once the effective size of each of a set of sieves is known, all sieve analyses made with the set can be corrected by a simple graphical process to give the same values as a set of standard sieves.

A limited number of the calibrated glass-sphere mixtures are available at a charge of $10.00 each from J. M. Brown, Secretary, Bone Char Research Project, Inc., % Revere Sugar Refinery, 333 Medford Street, Charlestown 29, Mass. Purchasers are requested to report their experience in the use of these spheres to Dr. V. R. Deitz, National Bureau of Standards.

WHO'S WHO

Arthur Smith

Arthur Smith, author of *"Zircon Sands — Properties and Uses in Cores and Facings,"* Page 64, is secretary of Millmaster Chemical Corp., New York . . . A native of Port Chester, N. Y., Mr. Smith received his degree in chemical engineering from Massachusetts Institute of Technology in 1918 and joined Aluminum Co. of America at Massena, N. Y., the following year . . . He then served, successively, as vice-president of Smith, Amgwine & Co., Port Chester, N. Y.; sales manager of Petroleum Fuels, Inc., Port Chester; director of development for Sterno Canned Heat, Inc., New York; and as chemical sales director for Pfaltz & Bauer, Inc., New York . . . In 1943, Mr. Smith became divisional manager of chemical sales for F. W. Beck & Co., Inc., New York, and when that organization was merged with Millmaster Chemical Corp. became secretary and a director of Millmaster.

F. E. Sutherland

F. E. Sutherland, author of *"Watch Your Cast Iron Chills!"* on Page 55, is technical assistant to the foundry superintendent, Dominion Engineering Works, Montreal . . . Mr. Sutherland, who attended the University of Manitoba and McGill University, served in the Canadian Army from 1940 to 1945 and has been with Dominion Engineering since 1948.

J. D. Wozny

John D. Wozny, author of *"Set Up Casting Welding Standards and Procedures,"* Page 72, is a lifelong resident of East Chicago, Ind., where he is today research metallurgist in the Research Laboratories at American Steel Foundries' Indiana Harbor Plant . . . Holder of a B.S. in metallurgical engineering from Purdue University in 1941, Mr. Wozny joined American Steel Foundries that same year as plant metallurgist . . . In 1944 he was named to his present position as research metallurgist . . . Mr. Wozny is also author of a paper on welding of castings which he presented at the 1948 A.F.S. Convention, Philadelphia.

D. C. Williams

Douglas C. Williams, author of *"Industrial Engineer in the Foundry,"* Page 88, is active in the A.F.S. Sand Division, serving as a member of its Executive Committee, Green Sand Properties Committee, and as chairman of its Mold Surface Committee . . . In his capacity as associate professor of industrial engineering at Ohio State University, Dr. Williams has been active in interesting engineering students in the foundry industry and has been instrumental in the formation of the A.F.S. Student Chapter at that institution, serving as it Faculty Advisor . . . A graduate of Beloit College, Dr. Williams entered the foundry industry as a member of the staff of American Steel Foundries' Research Laboratories, East Chicago, Ind., leaving there to attend Cornell University, where he received M.S. and Ph.D degrees and served as an A.F.S. Research Fellow, working under the late Dr. H. Ries on the A.F.S. Sand Research Project . . . In 1948, Dr. Williams was named assistant professor of industrial engineering at Ohio State University, where he is in charge of the school's foundry operations.

W. L. Miller

Walter L. Miller, co-author with George Norwitz of *"Determine Silicon-Copper-Iron in Monel Metal,"* Page 80, one of a series of articles on metallurgical chemistry that have appeared or will shortly appear in American Foundryman, is chemist-supervisor at New York Naval Shipyard's Material Laboratory, Brooklyn . . . A graduate of Columbia University in 1929, Mr. Miller joined Sherwin-Williams, Inc., Newark, N. J., that same year as chemist, leaving there to become chemist for the United States Food and Drug Administration, New York . . . In 1934, Mr. Miller was named chemist for the New York Naval Shipyard, Brooklyn, and in 1943 was appointed supervisor . . . A past vice-president of the Engineers Association of the Material Laboratory, Mr. Miller is an archer of national reputation, holding all present distance shooting records, using a plastic reinforced bow he invented.

George Norwitz

George Norwitz, co-author with Walter L. Miller of a series of articles on metallurgical chemistry that have appeared or are scheduled to appear in future issues of American Foundryman, is chemist in the Material Laboratory of New York Naval Shipyard . . . A graduate of Temple University, Mr. Norwitz was employed as a chemist at Philadelphia Naval Shipyard from 1941 to 1947, when he was transferred to the New York Naval Shipyard . . . He has published several articles on metallurgy in national chemical magazines.

Metropolitan Brass Founders Celebrate Anniversary

On the occasion of their 41st anniversary, some 200 members and friends of the Metropolitan Brass Founders Association, composed of non-ferrous foundrymen within a 50-mile radius of New York City, celebrated with a floor show and dance at the Hotel New Yorker. Highlight of the occasion was the presentation of a $200 savings bond to retiring Executive Secretary William E. Leary in appreciation of his services. Mr. Leary resigned last January to join the staff of Wright Aeronautical Corp., Wood Ridge, N. J. Presentation was made by Eugene Flamma, World Brass Foundry, Inc., association president. Mr. Leary is succeeded as executive secretary by George Staub, American Marine Brass Foundry, Inc., New York.

Entertainment Committee Chairman Patrick Halloran, Halloran's Brass Foundry, Inc., himself a past president of the Association, introduced three other past presidents: George Staub, American Marine Brass Foundry, Inc.; J. H. Sorenson, Columbus Foundry Co.; and Rudolf Ripple, Sunnyside Bronze Foundry, Inc., all of New York.

New AFS MEMBERS

NEW SUSTAINING MEMBERS

Darbyshire Steel Co., El Paso, Texas, M. S. Darbyshire, Pres. (Texas Chapter)—Conversion from Company.
Martin Engineering Co., Kewanee, Ill., Edwin F. Peterson, Pres. (Quad City Chapter)—Conversion from Company.

NEW COMPANY MEMBERS

Ann Arbor Foundry Co., Ann Arbor, Mich., Thomas Cook (Detroit Chapter).
Bagley & Sewall Co., Watertown, N. Y., W. W. Berrie, Fdy. Supt. (Central New York Chapter)—Conversion from Personal.
E. W. Bliss Co., Toledo, Ohio, B. J. Beirla, Fdy. Supt. (Toledo Chapter)—Conversion from Personal.
Budd Company, Philadelphia, Pa., J. Barclay Jones, Works Mgr. (Philadelphia Chapter).
S. Cheney & Son, Manlius, N. Y., Stephen S. Cheney, Pres. & Treas. (Central New York Chapter).
Colonial Smelting & Refining Co., Inc., Columbia, Pa., Martin Sanger, Treas. (Chesapeake Chapter).
Dean Bros. Pumps, Inc., Indianapolis, Ind., John G. Dean, Prod. Mgr. (Central Indiana Chapter).
Genesee Foundry Co., Syracuse, N. Y., John D. Mannigan, Gen. Mgr. (Central New York Chapter).
Hewitt-Robins, Inc., Passaic, N. J., W. F. Momary, Fdy. Equip. Sales & Dev. (Metropolitan Chapter).
C. T. Jacobsen Pattern Maker, San Francisco, Calif., Carrol W. Hillcourt, Owner (Northern California Chapter)—Conversion from Personal.
Javelin Fdries. & Mach. Wks., Ltd., Joliette, Que., Canada, John Doyle, Pres. (Eastern Canada Chapter).
Lakeside Bronze, Inc., Buffalo, N. Y., Leo G. Smith, Pres. & Secy. (Western New York, Chapter).
Maddox Fdy. & Mach. Wks., Inc., Archer, Fla., Charles F. Andrews, Vice Pres. & Gen. Mgr. (Birmingham Chapter)—Conversion from Personal.
Precision Metalsmiths, Inc., Cleveland, Ohio, Robert R. Miller, Pres. (Northeastern Ohio Chapter).
Rock Island Metal Fdy., Rock Island, Ill., Jim R. Grafton, Vice Pres. (Quad City Chapter).
Sollberger Engineering Co., Inc., Marshall, Texas, Gerald Smith, Pres. (Texas Chapter).
Western Alloyed Steel Casting Co., Minneapolis, Minn., H. F. Best (Twin City Chapter).

BIRMINGHAM DISTRICT CHAPTER

Harry M. Burns, Factory Mgr., Stockham Valves & Fittings, Inc., Birmingham.
J. R. Cardwell, Met., Stockham Valves & Fittings, Inc., Birmingham.
B. Y. Cooper, Master Mech., U. S. Pipe & Fdy. Co., Birmingham.
George L. Crimm, Fdy. Fmn., Jefferson Fdy. Co., Birmingham, Ala.
Wesley J. Estes, Met., U. S. Pipe & Fdy. Co., Birmingham.
William Fitzhugh Byrd, Jr., Asst. Met., Alabama Pipe Co., Anniston, Ala.
James W. Glaze, Fmn., Stockham Valves & Fittings, Inc., Birmingham.
C. B. Hasty, Jr., Quality Control Engr., U. S. Pipe & Fdy. Co., Birmingham.
R. N. Hays, Patt. Shop Fmn., Stockham Valves & Fittings, Inc., Birmingham.
H. S. Hunt, Prod. Supt., U. S. Pipe & Fdy. Co., Birmingham.
A. L. Jones, Plant Engr., U. S. Pipe & Fdy. Co., Bessemer, Ala.
Francis W. Lane, Jr., Sand Control Engr., Stockham Valves & Fittings, Inc., Birmingham.
Milton H. Lucky, Ind. Power Repr., Alabama Power Co., Anniston, Ala.
Edgar K. McWilliams, Fmn., Stockham Valves & Fittings, Inc., Birmingham.
Charles L. Monroe, Gen. Mgr., Standard Fdy. Mfg. Co., Rockingham, N. C.
R. W. Palmer, Melting Fmn., Stockham Valves & Fittings, Inc., Birmingham.
B. Lloyd Parsons, Molding Fmn., Stockham Valves & Fittings, Inc., Birmingham.
R. G. Phares, Industrial Engr., U. S. Pipe & Fdy. Co., Birmingham.
William Albert Quenell, Asst. Met., Alabama Pipe Co., Anniston, Ala.
Pete Rancont, Jr. Molding Fmn., Stockham Valves & Fittings, Inc., Birmingham.
Charles C. Salvage, Works Engr., James B. Clow & Sons, Birmingham.
Woodrow Stevens, Molding Fmn., Stockham Valves & Fittings, Inc., Birmingham.
W. H. Stuart, Molding Fmn., Stockham Valves & Fittings, Inc., Birmingham.
William J. Tutwiler, Chemist, Stockham Valves & Fittings, Inc., Birmingham.
R. E. Walters, Melting Fmn., Stockham Valves & Fittings, Inc., Birmingham.
A. J. Weller, Pattern Shop Supt., Central Foundry Co., Holt, Ala.
Henry West, Melting Fmn., Stockham Valves & Fittings, Inc., Birmingham.
J. M. Williams, Fmn., Stockham Valves & Fittings, Inc., Birmingham.
Felix Weaver Wood, Jr., Co-op Student, McWane Cast Iron Pipe Co., Birmingham.

BRITISH COLUMBIA CHAPTER

Alex Chisholm, Salesman, Shanahan's Ltd., Vancouver, B. C., Canada.
Frank E. Godwin, Fdy. Salesman, Overseas Commodities, Vancouver, B. C. Canada.

CANTON DISTRICT CHAPTER

Joseph E. Scandling, Chief Met., Marion Power Shovel Co., Marion, Ohio.
C. W. Ziegler, Chief Insp., Marion Power Shovel Co., Marion, Ohio.

CENTRAL ILLINOIS CHAPTER

Samuel P. Gartland, Service Engr., Independent Pneumatic Tool Co., Aurora, Ill.
C. C. Lawson, Gen. Supt., Wagner Malleable Iron Co., Decatur, Ill.
Wm. R. Messmore, Plant Engr., Wagner Malleable Iron Co., Decatur, Ill.
J. F. Powell, Gen. Supt., Caterpillar Tractor Co., Peoria, Ill.
Robert Walton, Fdy. Appr., Caterpillar Tractor Co., Peoria, Ill.
Lawrence Winings, Asst. Supt., Wagner Malleable Iron Co., Decatur, Ill.

CENTRAL INDIANA CHAPTER

Dean Bros. Pumps, Inc., Indianapolis, John G. Dean, Prod. Mgr.
Robert G. Draper, Coreroom Fmn., Central Fdy. Div. G. M. C., Danville, Ill.
Gerald Fred, Hoosier Works, Kokomo, Ind.
James J. Garrett, Asst. Plant Engr., Swayne, Robinson & Co., Richmond, Ind.
Robert Kimble, Section Engr., Fabricast Div., G. M. C., Bedford, Ind.
Harold E. LeConte, Coreroom Fmn., Central Fdy. Div., G.M.C., Danville, Ill.
John B. Lucas, Asst. Chief Engr., Heavy Alloy Sec., Fab. Div. G. M. C., Bedford, Ind.
Paul John Murphy, Student, Central Fdy. Div., G. M. C., Danville, Ill.
Glen H. Schluckebier, Coreroom Fmn., Central Fdy. Div. G. M. C., Danville, Ill.
Arnold Von Burg, Gen. Fmn., Nat'l. Malleable & Steel Castings. Co., Indianapolis.

CENTRAL MICHIGAN CHAPTER

Robert L. Daniels, Employment Mgr., Albion Malleable Iron Co., Albion, Mich.
Arthur H. Dove, Clark Equipment Co., Jackson, Mich.
N. J. Jacobs, Prod. Mgr., Albion Malleable Iron Co., Albion, Mich.
Gardner R. Lloyd, Sec., Albion Malleable Iron Co., Albion, Mich.

CENTRAL NEW YORK CHAPTER

S. Cheney & Son, Manlius, N. Y., Stephen S. Cheney, Pres. & Treas.
Dominick S. Fantacone, S. Cheney & Son, Manlius, N. Y.
Genesee Foundry Co., Syracuse, N. Y., John D. Mannigan, Gen. Mgr.
George R. Pickston, Vice Pres. & Factory Mgr., S. Cheney & Son, Manlius, N. Y.

CENTRAL OHIO CHAPTER

Robert P. Barry, Sales & Service Engr., Thiem Products, Inc., Columbus, Ohio.
Brown L. Miller, Salesman, Booty Resineers, Inc., Columbus, Ohio.
Mike Shuman, Mgr., Marion Casting Co., Inc., Marion, Ohio.

CHESAPEAKE CHAPTER

Richard P. Dunphy, Met., Naval Research Lab., Washington, D. C.
Donald Hoffman, Owner, Hoffman Pattern Works, Hanover, Pa.
Colonial Smelting & Refining Co., Inc., Columbia, Pa., Martin Sanger, Treas.
Harry H. Sommes, Prod. Mgr., Foundry Rubber, Inc., Bethesda, Md.

CHICAGO CHAPTER

Walter F. Craig, Jr., Met. Engr., Climax Molybdenum Co., Chicago.
L. T. Cuculic, Sales Engr., American Steel Foundries, East Chicago, Ind.
Ralph John Donat, Design Engr., National Engineering Co., Chicago.
W. I. Harshbarger, Sales, Hansell-Elcock Co., Chicago.
H. R. Hartmen, Owner, Trio Brass Foundry, Aurora.
Edwin J. Jory, Fdy. Engr., National Malleable & Steel Cstgs. Co., Cicero, Ill.
W. R. Neely, Salesman, Western Foundry Co., Chicago.
Walter B. Rowbottom, Salesman, Diversey Fdy. Co., Chicago.
Robert F. Schmidt, Met., H. Kramer & Co., Chicago.
Robert M. Shoemaker, Crane Co., Chicago.
George Di Sylvestro, Fdy. Tech., Burnside Steel Fdy., Chicago.
John Taylor, Vice Pres., Lester B. Knight & Associates, Inc., Chicago.
Ronald Webster, Secretary-Sales Mgr., Hydro-Blast Corp., Chicago.

CINCINNATI DISTRICT CHAPTER

Clifford E. Wenninger, Dir. of Fdy. Res. & Dev., College of Engr., Univ. of Kentucky, Lexington, Ky.

DETROIT CHAPTER

Joseph E. Collins, Jr., Appr. Patternmaker, Packard Motor Car Co., Detroit.
Ann Arbor Foundry Co., Ann Arbor, Mich., Thomas Cook.
Raymond Daksiewicz, Lab. Tech., Harry W. Dietert Co., Detroit.
John H. Dexheimer, Trainee, Wilson Fdy. & Mach. Co., Pontiac, Mich.
Randolph Dietert, Draftsman, Harry W. Dietert Co., Detroit.
Ray O. Dilley, Owner, Macomb Pattern & Mfg. Co., Detroit.
Anthony J. Fillipovitch, Supv., Plant Layout, Fort Motor Co., Dearborn, Mich.
George K. Hutzel, Met. Res. Engr., Ford Motor Co., Dearborn Mich.
George E. Isabell, Salesman, National Foundry Sand Co., Detroit.
Howard E. Jones, Jr., Dist. Sales Repr., Davis Fire Brick Co., Detroit.
Peter J. Kernan, Jr., Fdy. Process Tech. "A," Ford Motor Co., Dearborn, Mich.
Raymond G. Reiff, Met., Ford Motor Co., Dearborn, Mich.
Harold M. Simon, Plant Mgr. & Sales Mgr., Detroit Steel Castings Co., Detroit.
Gilbert James Weller, Fmn., Michigan Malleable Iron Co., Detroit.

EASTERN CANADA CHAPTER

William Byrne, Appr., Dominion Engineering Works, Lachine, Que.
Javelin Fdries. & Mach. Wks., Ltd., Joliette, Que., Canada, John Doyle, Pres.
Lucien La Barre, Supt., Darling Brothers, Montreal, Que., Canada.
Guy Latreille, Appr., Dominion Engineering Works, Ltd., Lachine, Que., Canada.
Fernand Lemieux, Appr., Dominion Engineering Works, Ltd., Lachine, Que., Canada.
Jack J. Monaco, Appr., Dominion Engineering Works, Ltd., Lachine, Que., Canada.
Patrick J. Nolan, Shop Supt., Canada Iron Foundry, Three Rivers, Que., Canada.
Max Reading, Fdy. Tech. (1BF), Fdy. Services (Canada) Ltd., Montreal, Que., Canada.
J. P. Roy, Singer Manufacturing Co., St, John, Que., Canada.

EASTERN NEW YORK CHAPTER

Edwin J. Bonesteel, General Electric Co., Schenectady, N. Y.
Geo. D. Cameron, Fmn., Patternmaker, Sheridan Iron Works, Champlain, N. Y.
Albert J. Demarais, Sand Tester, Rensselaer Valve Co., Cohoes, N. Y.
Ernest H. Goerold, Fdy. Supt., Ludlow Valve Co., Troy, N. Y.
Ralph J. Flint, Physical Met. Lab. Asst., Adirondack Fdy. & Steel Co., Watervliet, N. Y.
Lewis D. Fyvie, General Electric Co., Schenectady, N. Y.
Joseph E. Kremzier, Asst. to Supt., General Electric Co., Schenectady, N. Y.
Wm. L. Tromper, Gen. Fmn., Steel Fdy., General Electric Co., Schenectady, N. Y.

METROPOLITAN CHAPTER

R. R. Cook, Group Leader, Res. Dept., Monsanto Chemical Co., Plastic Div., Springfield, Mass.
Walter J. Grzybowski, Plant Supt., M. H. Detrick Co., Newark, N. J.
William G. Hess, Fdy. Fmn., Alloy Steel Products Co., Bloomfield, N. J.
Charles J. Kanes, Fdy. Engr., Whitehead Metal Products Co., Inc., New York.
John E. Langhans, Molder, U. S. Naval Shipyard, Brooklyn, N. Y.
Hewitt-Robins, Inc., Passaic, N. J., W. F. Momary, Equip. Sales & Dev.
Joseph C. Monzeglio, Pattern Shop, Alloy Steel Prod. Co., Bloomfield, N. J.
Andrew Edmund St. John, Sales & Service Engr., Barth Smelting Corp., Newark, N. J.
George Staub, Whitestone, N. Y.
E. J. Walsh, Jr., Fdy. Fmn., Alloy Steel Products, Co., Bloomfield, N. J.

MEXICO CITY CHAPTER

Jorge Zurgarramurdi Gonzalez, Licenciado en Ciencias Quimicas, Fundiciones de Hierro Y Acero, S. A., Mexico, D. F.
Sr. Enrique Varela, Mgr., Fundiciones de Hierro Y Acero, S.A., Mexico, D. F.

MICHIANA CHAPTER

David W. Davies, Night Supt., Auto Specialties Mfg. Co., Benton Harbor, Mich.
Dale Klinedinst, Gen. Fmn., Oliver Corp., South Bend, Ind.

MO-KAN CHAPTER

Alvin M. Bradley, Vice-Pres., General Aluminum Supply Co., Kansas City, Mo.
Walter Collins, Superior Brass & Aluminum Co., Independence, Mo.
T. F. Fallon, Salesman, General Refractories, Kansas City, Mo.
Homer Knight, Molder Fmn., Sheffield Steel Co., Kansas City, Mo.
George J. Scherer, Engr., Cramer Posture Chair Co., Inc., Kansas City, Mo.

NORTHEASTERN OHIO CHAPTER

Earl V. Baker, Fmn., Ferro Machine & Fdy. Co., Cleveland.
Sander Doman, Jr., Coreroom Fmn., Elyria Fdy. Div., Industrial Brownhoist Corp., Elyria, Ohio.
F. Kermit Donaldson, Exec. Vice-Pres., Steel Founders' Society of America, Cleveland.
Elmer Donnelly, Fdy. Mnn., Elyria Fdy. Div., Industrial Brownhoist Corp., Elyria, Ohio.
Robert L. Gollmar, Elyria Fdy. Div., Industrial Brownhoist Corp., Elyria, Ohio.
Roger E. Lawson, Service Engr., Master Pneumatic Tool Co., Inc., Cleveland.
Frances McCrann, Coreroom Fmn., Elyria Fdy. Div., Industrial Brownhoist Corp., Elyria, Ohio.
Joseph E. Micksch, Research Engr., Lake City Malleable Co., Cleveland.
Precision Metalsmiths, Inc., Cleveland, Robert R. Miller, Pres.
Carl R. Montsch, Plant Insp., Lake City Malleable Co., Cleveland.
Mayo E. Roe, Sales and Service, Werner G. Smith Div., Archer Daniels Midland Co., Cleveland.
Henry J. Srnka, Asst. Gen. Fdy. Supt., Ferro Machine & Fdy. Co., Cleveland.
William G. Thomas, Salesman, Carborundum Co., Cleveland.
M. Ayham Turkkan, Student, Case Institute of Tech., Cleveland.
Sherman S. Watts, Design Engr., Osborn Manufacturing Co., Cleveland.
Rudolph Weigl, Jr., Fdy. Fmn., Elyria Fdy. Div., Industrial Brownhoist Corp., Elyria, Ohio.
Edmund J. Whittenberger, Res. Met., Aluminum Co. of America, Cleveland.
Thomas B. Wilkinson, Salesman, Monsanto Chemical Co., Ashtabula, Ohio.

NORTHERN CALIFORNIA CHAPTER

Earl John Graf, Prod. Mgr., Pacific Fdy. Co., San Francisco.
Charles Hallam, Atlas Foundry, Richmond, Calif.
Chester H. Moork, Pacific Foundry Co., San Francisco.
Gordon W. Palmquist, Mgr., Knute Palmquist Fdy., Oakland, Calif.
T. H. Rathfeld, Sales Mgr., Atlas Foundry & Mfg. Co., Richmond, Calif.
Harold D. Sherrill, Chief Engr., Pacific Foundry Co., San Francisco.
Dave R. Sutch, Salesman, Brumley-Donaldson Co., Oakland, Calif.

NORTHERN ILLINOIS & SOUTHERN WISCONSIN

Kenneth Chamberlain, Partner, Atlas Pattern Works, Beloit, Wis.
Frank T. Gerl, Asst. Fmn., Greenlee Bros. & Co., Rockford, Ill.
Carl Mikkelsen, Partner, Atlas Pattern Works, Beloit, Wis.

NORTHWESTERN PENNSYLVANIA CHAPTER

William J. Holmes, Finishing Fmn., Griswold Mfg. Co., Erie, Pa.
John Kowalczyk, Labor Fmn., Griswold Mfg. Co., Erie, Pa.
Charles W. McConnell, Fmn., Urick Foundry Co., Erie, Pa.
Samuel J. McCracken, Fmn., Reed Manufacturing Co., Erie, Pa.
Donal F. Rupert, Trainee, Erie Malleable Iron Co., Erie, Pa.
Lawrence R. Stadler, Vice Pres. & Gen. Mgr., Superior Bronze Corp., Erie, Pa.

ONTARIO CHAPTER

John Allan, Fdy. Supt., Callender Fdy. & Mfg. Co., Ltd., Guelph, Ont., Canada.
Gardiner C. Fox, Salesman, Z. Wagman & Son, Ltd., Toronto, Ont., Canada.
Watson Hall, Sales Engr., American Wheelabrator & Equip. Corp., Toronto, Ont., Canada.
A. F. Laurence, Salesman, Neptune Meters Ltd., Toronto, Ont., Canada.
Stewart Lithgow, Asst. Fmn., Canadian Westinghouse Co., Ltd., Hamilton, Ont., Canada.
Thomas E. McCarthy, Sales Mgr., Dominion Starch Products, Ltd., Toronto, Ont., Canada.
Edson Reed, Gen. Mgr., Standard Castings Co., Ltd., Hespler, Ont., Canada.
George Stewart, Fmn., Canadian Westinghouse Co., Ltd., Hamilton, Ont., Canada.
Gerald Roy Tripp, Fdy. Layout Supv., Canadian Westinghouse Ltd., Hamilton, Ont., Canada.

OREGON CHAPTER

Sylvester P. Krukowski, Office Employee, Electric Steel Fdy. Co., Portland, Ore.
Harold F. Luik, Plant Mgr., Magnus Metal Div., National Lead Co., Portland, Ore.
William H. Sullivan, Lab. Asst., Electric Steel Foundry, Portland, Ore.
M. O. Woodall, Asst. Mgr., Rich Mfg. Co., Portland, Ore.

PHILADELPHIA CHAPTER

Larry Berger, Jr., Sales Engr., Swan-Finch Oil Corp., Philadelphia.
John D. Craig, Jr. Tech. Field Engr., Pennsylvania Glass Sand Corp., Trenton, N. J.
Ernest F. Fisher, York, Pa.
Burton J. Hollister, General Grinding Wheel Corp., Philadelphia.
J. Barclay Jones, Works Mgr., Budd Company, Philadelphia.
C. S. Roberts, Jr., Dodge Steel Corp., Philadelphia.
Ned W. Roudabush, Ceramic Engr., General Refractories Co., Philadelphia.

QUAD CITY CHAPTER

Ira L. Chandler, Fmn., John Deere Planter Works, Moline, Ill.
H. L. Davis, Gen. Supt., Nye Tool Co., Galesburg, Ill.
H. E. Gildner, Pres., East End Fdy., Inc., Ft. Dodge, Iowa.
Rock Island Metal Fdy., Rock Island, Ill., Jim R. Grafton, Vice Pres.
Lyle R. Jenkins, Met., Union Malleable Iron Works, East Moline, Ill.
R. C. Jensen, Cleveland Flux Co., Davenport, Iowa.
Arlo G. Lundberg, Met., John Deere Spreader Works, Rock Island, Ill.
Donald F. Moon, Fdy. Fmn., John Deere Spreader Works, Rock Island, Ill.
Stanley T. Mrozek, Gen. Mgr., Nye Tool Co., Galesburg, Ill.
Lewis H. Smith, Utility Man, John Deere Planter Works, Moline, Ill.
F. Paul Snyder, Chief Insp. Fdy., J. I. Case Co., Davenport, Iowa.
Louis M. Wick, Fdy. Supt., Rock Island Metal Fdy., Rock Island, Ill.

ROCHESTER CHAPTER

Donald F. Baxter, Sales Repr., Carborundum Co., Webster, N. Y.
James Demmler, Sales Engr., Aluminum Co. of America, Rochester, N. Y.
Herbert Senger, Fmn., Ritter, Inc., Rochester, N. Y.

SAGINAW VALLEY CHAPTER

Frank G. Carpenter, Fmn., Chev. Grey Iron Fdy., G.M.C., Saginaw, Mich.
Rutherford Cooper, Draftsman, General Fdy. & Mfg. Co., Flint, Mich.
Richard A. Enters, Engr., Chev. Grey Iron Fdy., G.M.C., Saginaw, Mich.
Samuel Stewart Fair, Sec.-Treas., Valley Steel Casting Co., Bay City, Mich.
Hazan L. Kennys, Shakeout Fmn., Chev. Grey Iron Fdy., G.M.C., Saginaw, Mich.
Joe K. Russell, Lab. Met., Buick Div., G.M.C., Flint, Mich.
Paul Wm. Tietz, Fmn., Chev. Grey Iron Fdy., G.M.C., Saginaw, Mich.

ST. LOUIS DISTRICT CHAPTER

William L. Bevan, Spec. Engr., Ind. Engr. Dept., American Steel Foundries, St. Louis.
M. D. Brandwine, Owner, Brandwine Equipment Co., St. Louis.
Troy V. Durban, Cleaning Room Fmn., Semi Steel Cstgs. Co., St. Louis.
G. A. Fisher, Jr., Mgr., St. Louis Tech. Section, International Nickel Co., Inc., St. Louis.
James T. Roberts, Service Engr., Master Pneumatic Tool Co., St. Louis.

SOUTHERN CALIFORNIA

Howard Alper, Malleable Fittings Corp., Los Angeles.
Alfred Anderson, Pattern Storage Fmn., Westlectric Catsings, Los Angeles.
Charles H. Dickson, Met., General Metals Corp., Los Angeles.
George J. Knoch, Coreroom Fmn., Westlectric Castings, Los Angeles.
W. B. McCartney, Jr., Sales, Los Angeles Steel Casting Co., Los Angeles.
William J. Pechie, Jr., Reliance Regulator Div., American Meter Co., Alhambra, Calif.
Donald M. Rice, Service Engr., Laclede Christy, Vernon, Calif.

TENNESSEE CHAPTER

Albert B. Hicks, Draftsman, Combustion Eng. Superheater, Inc., Chattanooga, Tenn.
Jim Abe Jackson, Dist. Sales Mgr., Mexico Refractories Co., Chattanooga, Tenn.
H. A. Vestal, Jr., Pres., Vestal Stove Co., Sweetwater, Tenn.
James E. Vestal, Gen. Mgr., Vestal Stove Co., Sweetwater, Tenn.

TEXAS CHAPTER

W. G. Coley, Owner, Longview Brass & Aluminum Co., Longview, Texas.
F. H. Gregorczyk, Coremaker, American Brass Fdy., Fort Worth, Texas.
Dick Matheny, Asst. Supt., Sollberger Engineering Co., Marshall, Texas.
C. V. Smith, Jr., Vice Pres., Sollberger Engineering Co., Marshall, Texas.
Sollberger Engineering Co., Marshall, Texas, Gerald Smith, Pres.

TWIN CITY CHAPTER

Western Alloyed Steel Casting Co., Minneapolis, H. F. Best.
Michael Wasowicz, Fmn., Northern Malleable Iron Co., St. Paul.
Vernon S. Nelson, Asst. Fmn., Northern Malleable Iron Co., St. Paul.

TIMBERLINE CHAPTER

R. H. Muench, C. S. Card Iron Works Co., Denver, Colo.

TOLEDO CHAPTER

John Baronowski, Fdy Fmn., Nights, E. W. Bliss Co., Toledo, Ohio.
Harold Cramer, Maintenance Fmn., E. W. Bliss Co., Toledo, Ohio.
Hugh Curtis, Prod. Control, E. W. Bliss Co., Toledo, Ohio.
Edward Downey, Fmn., Coreroom, E. W. Bliss Co., Toledo, Ohio.
Clare Farbrother, Fmn., Pattern Storage, E. W. Bliss Co., Toledo, Ohio.
A. V. Gleespen, Fmn., Main Floor Molding, E. W. Bliss, Toledo, Ohio.
Charles A. Greenlee, Asst. Met. Engr., Basic Refractories, Maple Grove, Ohio.
John Muir, Fmn., Side Floor, E. W. Bliss Co., Toledo, Ohio.
Robert Newell, Gen. Fmn., E. W. Bliss Co., Toledo, Ohio.
Edward E. Oldfield, Fmn., Cupola, E. W. Bliss Co., Toledo, Ohio.
Fred Paepke, Fmn., Machine Molders, E. W. Bliss Co., Toledo, Ohio.
John A. Schumann, Met., Central Foundry Div., G.M.C., Defiance, Ohio.
John Soncha, Fmn., Yard, E. W. Bliss Co., Toledo, Ohio.
K. W. Stromberger, Plant Mgr., U. S. Reduction Co., Toledo, Ohio.
John Tauffman, Fmn., Pattern Shop, E. W. Bliss Co., Toledo, Ohio.
Elmer Thomas, Fmn., Med. Mldg. Floor, E. W. Bliss Co., Toledo, Ohio.
Richard Thomas, Fmn., Chipping Room, E. W. Bliss Co., Toledo, Ohio.

TRI-STATE CHAPTER

Kenneth Henry Wisby, Sales Engr., Carborundum Co., Tulsa, Okla.

WASHINGTON CHAPTER

R. N. Tompkins, Secy.-Treas., Western Fdy. Sand Co., Seattle, Wash.

WESTERN MICHIGAN CHAPTER

William T. Holt, Jr., Enterprise Brass Works, Muskegon, Mich.
Albert Larsen, Enterprise Brass Works, Muskegon, Mich.
Edward Saukas, Fdy. Supt., American Seating Co., Grand Rapids, Mich.
E. L. Smitherman, Parma, Mich.
Erle T. Ziel, Supt of Heat Treat & Welding, Lakey Fdy. & Mach. Co., Muskegon, Mich.

WESTERN NEW YORK CHAPTER

Paul T. Anderson, Asst. Fdy. Supt., Clark Brothers, Olean, N. Y.
Clyde E. Ayres, Student, Buffalo State Tech. Inst., Buffalo.
Roy T. Barnett, Salesman, Brvco Inc., Kenmore, N. Y.
Sherman Butler Burke, Dist. Sales Mgr., Hanna Furnace Corp., Buffalo.
Walter Dziwulski, Student, Buffalo State Tech. Inst., Buffalo.
Edward A. Eisele, Fmn., Worthington Pump & Mach. Corp., Buffalo.
Armento Lewis, Buffalo.
Joseph J. Mayer, Vice Pres. & Gen. Supt., Lumen Bearing Co., Buffalo.
John R. Persons, Sales Engr., K & L Refractory Service, East Aurora, N. Y.
Lakeside Bronze, Inc., Buffalo, Leo G. Smith, Pres. & Secy.
David Stein, Samuel Greenfield Co., Inc., Buffalo.
Robert D. Young, Purch. Agent, Lumen Bearing Co., Buffalo.

WISCONSIN CHAPTER

Frederick D. Busche, Sales, Walter Gerlinger Engrg. Co., Milwaukee.
Richard Dyner, Gen. Mgr., Marathon Foundry & Mach. Co., Wausau, Wis.
Edward G. Gibson, Student Engr. Trainee, Chain Belt Co., Milwaukee.
Daniel G. Jencks, Plant Engr., Grede Foundries, Inc., Milwaukee.
Stephen Pohl, Fdy. Supt., Federal Malleable Co., West Allis, Wis.
Robert J. Russell, Sales Engr., Fire Brick Engineers Co., Milwaukee.
John H. Spehr, Abrasive Sales Engr., Carborundum Co., Milwaukee.
Chester W. Spencer, Student, University of Wisconsin, Madison, Wis.
C. A. Stegemeyer, Asst. Treas., Federal Malleable Co., West Allis, Wis.
James S. Stubbe, Koehring Company Fdy. Div., Milwaukee.
John Szoke, Fdy. Supt., Lakeside Bronze, Inc., Milwaukee.
C. L. Tanner, Salesman, Fire Brick Engineers Co., Milwaukee.

STUDENT CHAPTERS

MIT

William L. Benfer — Leonard Bernard Gross — Richard Paul Simmons

MISSOURI SCHOOL OF MINES

Reinhard P. Abendroth — Howard Bullman — Richard Harold Danzer
Bernard Paul Dowd

NORTHWESTERN UNIVERSITY

Thomas H. Brinkmann — Calvin E. Teuber — William G. Whitney

OHIO STATE UNIVERSITY

William H. Cox — Robert W. Rullman

UNIVERSITY OF ALABAMA

Jack E. Bolt — Tommy Caldwell — Jefferson D. Cowen
George S. Eastwood, II — Chas. W. Hall, Jr. — John Donald Lunn
Robert E. Sherwin — William P. Whitan

UNIVERSITY OF ILLINOIS

Edward C. Beach, Willard V. Putz, Desmond F. Collord, Jack E. Schwind, LeRoy Davidson, Philip Michael Tuzi

UNIVERSITY OF MINNESOTA

Richard William Clarke

OUTSIDE OF CHAPTER

Carl E. Erickson, Pres., Franklin Foundry Co., Inc., Hyde Park, Mass.
J. C. Hagler, III, Asst. to Pres., Georgia Iron Works Co., Augusta, Ga.
Talmadge T. Higginbottom, Fdy. Supt., Georgia Iron Works Co., Augusta, Ga.
Ralph Porter Kimmel, Asst. Chief Met., United States Steel Co., Johnstown Works, Johnstown, Pa.

INTERNATIONAL

Cuba

Manuel E. Castillo Echarte, Engeneer, Ingenieros Cubanos, Arroyo Apolo, Havana, Cuba.

England

C. H. Bedford, Fulmer Research Institute, Buckinghamshire, England.

Germany

Paul Brenner, Dir. of Research, Aluminium Werke A. G. and Vereinigte, Bonn, Germany.

New Publication Helps Foundrymen Apply Sand Testing To Production

CONTROL OF SAND by laboratory test alone does not give desired results, according to E. C. Troy, foundry engineer, Palmyra, N. J., in the introduction to SYMPOSIUM ON INTERPRETATION AND APPLICATION OF SAND TEST DATA FOR THE PRODUCTION OF QUALITY STEEL CASTINGS, 75-page publication just issued by the American Foundrymen's Society. However, he points out, such sand testing as the average foundry employs is helpful.

A project sponsored jointly by the A.F.S. Sand and Steel Divisions, the symposium was presented at the 54th Annual Convention of the Society. Authors of the symposium and their subjects are:

"Room Temperature Tests," J. H. Lowe, Wehr Steel Co., Milwaukee.

"Statistical Control of Green Sand Properties," W. J. Downey, Burnside Steel Foundry Co., Chicago.

"Properties of Steel Sands at Elevated Temperatures," P. E. Kyle, Cornell University, Ithaca, N. Y.

"Use of High Temperature Testing in Control of Steel Foundry Sand," R. H. Jacoby and J. W. Mitchell, Key Co., East St. Louis, Ill.

"Interpretation and Application of Sand Test Data for Production of Quality Steel Castings, with Reference to the Expansion Test," Henry W. Meyer, General Steel Castings Corp., Granity City, Ill.

"Relationship of Elevated Temperature Sand Test Results to Hot Tear Occurrence in Steel Castings," J. A. Rassenfoss, American Steel Foundries, East Chicago, Ind.

"The Dip Test," J. B. Caine, consultant, Wyoming, Ohio.

Helping fill the gap between sand testing and production of sound castings, the authors describe methods for evaluating sand test data and give details of experiments conducted under carefully controlled conditions to correlate laboratory results with test or production castings.

SYMPOSIUM ON INTERPRETATION AND APPLICATION OF SAND TEST DATA FOR THE PRODUCTION OF QUALITY STEEL CASTINGS is a paper-bound book, 8½ x 11 in., with 45 figures, 13 tables, and 20 references. Price to A.F.S. members is $3.00; non-member price is $4.75. Orders should be sent to: American Foundrymen's Society, 616 South Michigan Ave., Chicago 5, Ill. Postage is prepaid if remittance accompanies order.

Finds Magnesium Will Dephosphorize Molten Iron When Added In Ladle

J. E. Rehder, Foundry Engineer
Dept. of Mines & Technical Surveys
Ottawa, Ontario, Canada

DEPHOSPHORIZATION of cast iron by means of magnesium is indicated by work done in studies on nodular iron. Some time ago, the writer was making trials of briquets for introducing magnesium into cast iron. The briquets were composed of a mechanical mixture of crushed silicon-zirconium alloy and magnesium powder. The iron to which the briquets were added was an induction-furnace melted pig iron at 1430 C, containing about 3.8 per cent carbon, 2.0 per cent silicon, and 0.7-0.8 per cent manganese.

DEPHOSPHORIZING INFLUENCE OF MAGNESIUM

		Per cent			
Trial	Mg Added	S	P	Mg	Dephosphorization
1		0.030	0.185	0.00	
	0.50	0.022	0.090	0.070	51.3
2		0.070	0.185	0.00	
	0.50	0.060	0.085	0.63	52.7
3		0.033	0.170	0.00	
	0.50	0.023	0.045	0.061	73.5
4		0.069	0.185	0.00	
	0.037	0.031	0.125	0.037	32
5		0.114	0.027	0.00	
	0.34	0.083	0.013	0.049	52
6		0.125	0.018	0.00	
	0.057	0.021	0.014	0.008	22

The iron was treated in 50 lb batches and a post inoculant of 1.0 per cent silicon as a silicon-manganese-zirconium alloy was added in each case. The object was to introduce magnesium, the dephosphorizing action being incidental. The table shows the results of six trials, the last three performed some months after the first three. Chemical analyses were performed on drillings from test bars poured before and after addition of briquets.

Analytical Methods Used

In trials, 2, 4, 5, and 6, sulphur was added to the furnace to increase initial sulphur content. In trials 5 and 6 a synthetic low phosphorus pig iron was used, of otherwise similar composition. Sulphur determinations were by the combustion method, phosphorus by the standard gravimetric method, and magnesium by the wet, mercury cathode method. The phosphorus determinations were rechecked in duplicate with referee standards.

Work with the briquets has been discontinued but in later work on nodular irons, dephosphorization of zero to 15 per cent has been noted with all the usual additives, such as nickel-magnesium, copper-magnesium, and iron-silicon-magnesium alloys. The effect is erratic and no systematic study has been made. It is apparent, however, that dephosphorization is easier at higher phosphorus contents, as would be expected. The conditions for reproducible or large dephosphorizations are not known to the author at present; work in this direction is being instituted.

FOUNDRY personalities

Richard L. Bradley has been named to direct activities of an expanding training and special programs division of Lester B. Knight & Associates, Inc., Chicago. Mr. Bradley, who comes to Knight from the Corporation Service Division of LaSalle

R. L. Bradley

Extension University, has been active for several years in business training, sales promotion and marketing and has prepared sales, merchandising, management and supervisory programs used by companies in a number of different industries.

R. A. J. Wellington, general sales manager of Precision Metalsmiths, Inc., Cleveland, since 1949 has been named vice-president in charge of sales, and **Richard W. Devans**, vice-president in charge of

R. A. J. Wellington

purchasing, will also assume the duties of company treasurer and assistant to President Robert R. Miller.

Clifford R. Taylor, president and treasurer of The Chas. Taylor Sons Co., Cincinnati, has been appointed a member of the Refractories Industries Committee of the National Production Authority, recently created by the Department of Commerce to advise that body on special industry problems relating to the National defense effort. Mr. Taylor is also a member of the Army and Navy Munitions Board and during World War II served on the Refractory Industry Committee of the War Production Board.

William F. MacDonald was recently elected president of E. F. Houghton & Co. of Canada, succeeding the late G. W. Pressell. **E. H. MacInnis** continues as vice-president and sales manager at the company's headquarters at 100 Symes St., Toronto.

Miss D. Ostroff was recently elected president of Thomas Paulson & Son, Inc. Brooklyn, N. Y., foundry. Miss Ostroff has been associated with the Paulson foundry

Miss D. Ostroff

for 18 years. Starting as a secretary in 1932, she has steadily increased her practical knowledge of the industry and was appointed manager of the company in 1941. Since the death of William E. Paulson last year she has been in complete charge of Thomas Paulson & Son, Inc., one of the nation's oldest non-ferrous foundries.

Towner K. Webster has retired from active management of the Hydroblast Corporation and is now chairman of the Board of Directors. **Paul H. Dunawin**, who has served as executive vice-president of the company for the last year, has retired and will devote his time to private law practice. New officers of the company are **Roderick S. Webster**, president; **Robert K. Strong**, vice-president and treasurer; **D. H. Petty**, vice-president; and **Ronald Webster**, secretary.

W. J. McBrian, vice-president of the Caterpillar Tractor Co., Peoria, Ill., has accepted the position of vice-chairman of the Munitions Board, where he will be responsible for procurement and distribution for the Military departments and will

W. J. McBrian

direct and coordinate the work of six important offices and agencies. As treasurer and as vice-president of Caterpillar during World War II, Mr. McBrian was active in procurement, priorities and expediting vital war materiel.

George Habian, engineer for Western Electric Co., Inc., New York, recently was awarded the top cash prize of $300 in the Steel Founders' Society of America's international design awards program to

George Habian

stimulate advanced steel castings engineering design. Mr. Habian submitted a paper and plans for cable reel saddle steel castings. Second prize of $200 went to **Charles L. Babb**, engineer in charge of design, Centrifugal Pump Dept., Allis-

Chalmers Mfg. Co., Milwaukee, who submitted steel casting designs for outer barrel and suction nozzle ends for a high-pressure multi-stage centrifugal pump. Third prize of $100 was awarded **Leonard G. Daniels**, research metallurgist, Thompson Products, Inc., Euclid, Ohio, who was a member of Precision Metalsmiths, Inc., at the time of submitting a design for production of an aviation selector valve cylinder entailing conversion from welded assembly to steel investment casting. Other award recipients were: **L. N. Tangeman**, Dempster Mill Mfg. Co., Beatrice, Neb.; **Orrin F. Arnold**, Bacon Vulcanizer Mfg. Co., Oakland, Calif.; **Joseph E. Cruse**, Continental Farm Equipment Co., Omaha; **Robert E. Greenawalt**, Salem-Brosius, Inc., Salem, Ohio; **Leo A. Chartier**, Wilson Trailer Co., Sioux City, Iowa; **J. C. King**, Minneapolis Honeywell Regulator Co., Philadelphia; **Theodore Cachowski**, Truscon Steel Co., Youngstown, Ohio; **Loy D. Rhoads**, General Excavator Co., Marion, Ohio; and **H. W. Gunther**, design engineer, Paris, France.

J. W. Stuart has been named eastern territory machine sales representative for

J. W. Stuart

the Osborn Manufacturing Co., succeeding the late **George G. Adams**. Mr. Stuart, who has been in the foundry industry since 1933, was formerly foundry manager of the Products Machine & Foundry Co., Bridgeport, Conn., and is a graduate of Tri-State College, Angola, Ind.

William E. Mahin, director of research at Armour Research Foundation of Illinois Institute of Technology, has been named director of the metallurgical projects division of the new Metallurgical Advisory Board, National Research Council. The Board, composed of leading industrial and academic metallurgists, will advise the Department of Defense on the research aspects of some of the nation's most critical metals problems. Mr. Mahin will spend three days each week in Washington, D. C., and the remainder of his time will be devoted to research administration at the Armour Research Foundation.

Anthony J. Zino, Jr., formerly sales promotion manager and chief lubrication sales engineer for the Swan-Finch Oil

(Continued on Page 123)

A. F. S. CHAPTER DIRECTORY

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UNIVERSITY OF ALABAMA *Secretary*, Robert J. Price
NORTHWESTERN UNIVERSITY *Secretary-Treasurer*, Robert Ball

Winners of Detroit Chapter's Wood and Metal Pattern-making Apprentice Contest honored at the Chapter's annual Old Timers and Apprentices Night March 16, are, left to right: Robert E. Bloch and Louis Conz of Cadillac Motor Div., GMC; Joseph Collins, Packard Motor Car Co.; Edward Young and James Sosey of Ford Motor Co.; and Charles Hands, Century Pattern Works. Photo: Walter Ring, Cadillac Motor Division.

CHAPTER ACTIVITIES NEWS

Central Illinois

Robert J. Paluska
Caterpillar Tractor Co.
Chapter Publicity Chairman

MARCH DINNER MEETING found 120 members and guests on hand to welcome two distinguished visitors—A.F.S. National President Walton L. Woody and A.F.S. National Secretary-Treasurer Wm. W. Maloney.

National Director Frank W. Shipley, Caterpillar Tractor Co., Peoria, Ill., a charter member and past chairman of the chapter, introduced Messrs. Woody and Maloney and each gave a brief talk about the Society.

Mr. Woody pointed out some of the many things the Society does to further its aim—to make the foundry a better place to work—and Mr. Maloney remarked that A.F.S. has grown to more than 9,500 members, belonging to 40 chapters and 10 student chapters in the United States, Canada and Mexico, and from overseas.

Guest speaker for the meeting Frank S. Brewster, Harry W. Dietert Co., Detroit, speaking on sand control, stated, "The proper sand mixture is very important in obtaining higher production, in making a better quality casting, and in decreasing scrap." To emphasize the importance of sand control in the foundry, Mr. Brewster showed a number of charts and graphs showing results of experiments conducted in the Dietert laboratories.

Benard N. Ames, New York Naval Shipyard, Brooklyn, Technical Chairman for Metropolitan Chapter's March 5 meeting, talking foundry shop with Speaker Clyde L. Frear of the Navy's Bureau of Ships, Washington, D. C. (Photograph: John Bing, Metropolitan Refractories Corp., New York.)

Tennessee

Carl A. Fischer, Jr.
Fischer Supply Co.
Chapter Reporter

REGULAR DINNER MEETING of the chapter was held February 23 at the Hotel Patten, Chattanooga, with approximately 40 members and guests attending.

Speaker of the evening was J. M. Kane, American Air Filter Co., Louisville, who spoke on *"Present Day Thinking on Control Methods for Dust and Fumes Within the Foundry and for the Surrounding Neighborhood,"* and showed slides to illustrate his talk.

Mr. Kane stressed adequate dust and fume control in the foundry as playing an important part in efficient foundry operation and in safeguarding the health of employees. He said many

states are now forcing industry to take proper steps for dust control. A question and answer period was held at the end of the session and members expressed much interest in dust control and air pollution.

Chairman Paul Arnold, U. S. Pipe & Foundry Co., appointed a committee to nominate chapter officers and directors for the coming year. Heading the committee is W. P. Delaney, Eureka Foundry Co. Members are Karl Landgrebe, The Wheland Co.; Paul H. Stuff, Ross Meehan Foundries; Sam C. Northington, Combustion Engineering Co.; and Carl Fischer, Fischer Supply Co.

Southern California

S. L. Jackson
Electro Metallurgical Div., Union Carbide & Carbon Corp.
Publicity Chairman

MARCH MEETING was held March 9 at the Rodger Young Auditorium. Following a brief business meeting, the Chapter heard Joseph A. Gitzen, Delta Oil Products Co., Milwaukee, speak on *"The Proper Use of Sand Additives,"* in which he described his experiences in compiling facts on additives for some 26 years. Mr. Gitzen's talk was interesting and informative.

Michigan State College

Kenneth E. Spray
Chapter Reporter

FINAL PLANS for the Student-Industry Banquet, to be held May 16, were made during the business session of the February 6 meeting of the Student Chapter. The purpose of the banquet is to promote closer relations between students and the foundry industry.

The technical session featured an illustrated lecture on *"Foundry Mechanization"* by John Watson, C. O. Bartlett and Snow Co., who was assisted by Messrs. Kebort and Watson, also of C. O. Bartlett and Snow Co.

Mr. Watson pointed out that mechanization is vital to high production, but that the small foundry must guard against bottlenecks formed by overmechanization of any one department.

Slides on plant layouts of some modern Midwest foundries served as a background for Mr. Watson's interesting talk.

St. Louis District

Norman L. Peukert
Carondelet Foundry Co.
Chapter Reporter

MARCH 8 MEETING speaker was R. L. McIlvaine, National Engineering Co., Chicago, who discussed *"What to Look for in a Mechanized Molding System."*

The speaker supplemented his presentation with large sketches showing differences between well-designed and poorly-designed molding systems. Cit-

Enjoying a smoke after a hearty dinner at Wisconsin Chapter's February meeting was this group of foundrymen caught by the camera of Chapter Photographer Walter V. Napp, Wisconsin Fire Brick and Supply Company.

S. D. Martin, Central Foundry Division, General Motors Corp., Danville, Ill. center, points out an example of foundry advances made through motion study to, left, H. G. Haines, Howard Foundry Co., Lecture Course Chairman, at a recent Chicago Chapter Lecture Series meeting. Looking on at right is Charles Druery also of Central Foundry Div., Danville.

Snapped at Southern California's March meeting were Chapter Vice-President Henry Howell, Howell Foundry Co.; Speaker J. A. Gitzen, Delta Oil Products Co., Milwaukee; and Chapter President John Wilson, Climax Molybdenum Co. (Photograph: Kenneth Sheckler, Calmo Engineering Co.)

ing two mechanized molding systems operating in the same foundry, Mr. McIlvaine said that one system, constructed and installed with inferior materials and carelessly designed, has never equalled the other, a well-designed unit made of high-quality materials, in production.

Using a lucite model of a storage bin, Mr. McIlvaine filled it with alternate layers of red and white sand to illustrate how sand feeds out of the center of the bin, leaving the sides unmoved. If new sand is constantly fed into the bin, it will pass straight through, according to Mr. McIlvaine. Thus, he said, it is necessary to have two bins, so that one can be completely emptied while the other is refilling. A lively discussion period followed the talk.

R. L. McIlvaine, National Engineering Co., Chicago, discusses mechanized molding systems at St. Louis District's March meet.

FUTURE CHAPTER MEETINGS

● MAY 15
EASTERN NEW YORK
Circle Inn, Lathams
HOWARD NYE
Crompton & Knowles Loom Works
ROUND TABLE DISCUSSIONS

● MAY 17
DETROIT
Cadillac Motor Div., GMC, Cadillac, Mich.
PLANT VISITATION NIGHT

● MAY 18
TEXAS
Texas State Hotel, Houston
ANNUAL BUSINESS MEETING

● MAY 21
OREGON
Heathman Hotel, Portland
Sound-color film: *"Fluid Flow in Transparent Molds—II"*

QUAD CITY
Ft. Armstrong Hotel, Rock Island, Ill.
F. G. STEINEBACH
Penton Publishing Co.
"What's Ahead"

● MAY 23
CENTRAL MICHIGAN
Hart Hotel, Battle Creek
WALTER HUMMEL
Campbell, Wyant & Cannon Foundry Co.
"Costs and Human Relations"

Quad City

E. C. Zirzow
Deere & Co.
Chapter Reporter

TWO HUNDRED FOUNDRYMEN turned out for the March 9 meeting to greet A. F. S. National Director Frank W. Shipley, Caterpillar Tractor Co., Peoria, Ill., National Secretary-Treasurer Wm. W. Maloney and A.F.S. Technical Director S. C. Massari.

Mr. Massari provided the commentary for the feature event of the evening—showing of the A.F.S. Research Film, *"Fluid Flow in Transparent Molds—II,"* sponsored by the Society's Aluminum & Magnesium Division.

At a management luncheon held prior to the regular meeting, National Director Frank Shipley spoke on *"How Does A.F.S. Membership Help The Foundryman?,"* in which he pointed out that where top management has lost personal contact with the Society it should appoint or delegate someone to represent it in the Society. Mr. Shipley concluded by pointing out the value of interchange of ideas and said that one idea gained is often worth more than the cost of membership.

Tennessee

Carl A. Fischer, Jr.
Fischer Supply Co.
Chapter Reporter

MARCH 23 MEETING was held at the Hotel Patten, Chattanooga, with approximately 45 members and guests attending. Paul Arnold, U. S. Pipe & Foundry Co., Chattanooga, spoke on *"Centrifugal Castings."*

Illustrating his talk with slides, the speaker outlined the development of centrifugal casting from its earliest conception to the present. Citing as the most modern example of centrifugal casting, the making of pipe with an outer coating of steel or iron and an inner coating of copper or similar metal, Mr. Arnold said the blending of the two metals is so perfect that it is hardly possible to tell where one stops and the other begins. Porter Warner, Jr., Porter Warner Industries, Chattanooga, presided at the meeting.

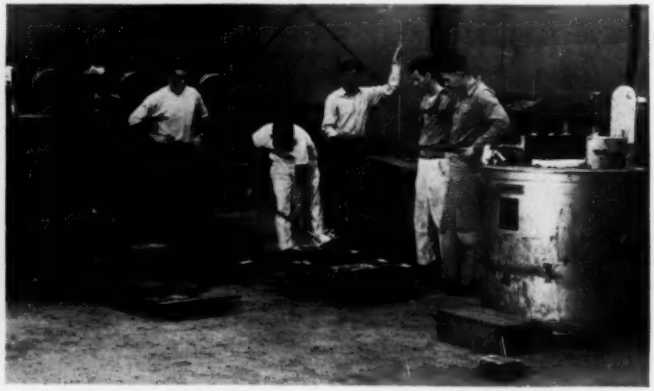
Mexico City

N. S. Covacevich
La Consolidada, S. A.
Chapter Chairman

March 1 meeting was a triple feature, opening with a program by Francisco Diaz Covarrubias and F. Gonzalez Vargas, followed by a showing of two Whiting Corporation films on foundry mechanization, and climaxed by election of officers for 1951-52.

Officers and directors elected are:

Chairman, N. S. Covacevich, La Consolidada, S. A.; vice-chairman, Juan



Oregon State College Chapter students pouring aluminum in the College's Metal Casting Laboratory are, left to right: W. D. Macomber, L. J. D'Assisi, K. J. Allen, A. M. Thompson R. R. Johnson. (Photo: C. Palmer.)

FUTURE CHAPTER MEETINGS

● ***MAY 24***
NORTHEASTERN OHIO
Tudor Arms Hotel, Cleveland
PAST PRESIDENTS & NATIONAL OFFICERS' NIGHT

● ***MAY 28***
NORTHWESTERN PENNSYLVANIA
Moose Club, Erie
F. G. STEINEBACH
Penton Publishing Co.
"What's Ahead"
TOP MANAGEMENT NIGHT

● ***JUNE 16***
DETROIT
Place to be announced
ANNUAL OUTING

● ***JUNE 19***
EASTERN NEW YORK
Meeting place to be announced
ANNUAL PICNIC

● ***JUNE 21***
CINCINNATI DISTRICT
Summit Hills Country Club, Cincinnati
STAG PICNIC AND GOLF

● ***JUNE 23***
TOLEDO
Adams Township
Conservation Club
ANNUAL PICNIC

Latapi Sarre, Fundicion de Hierro y Acero, S. A.; secretary-treasurer, Francisco Diaz Covarrubias, La Consolidada, S. A. Directors (terms expire June, 1951): Luis Delgado Vega, Casco S. de R. L.; and Isidro Lopez, El Nervion, S. A. Director (term expires June, 1952): Francisco Madrigal, Fundicion de Aceros Tepeyac, S. A. All of the new chapter officers and directors are from Mexico City.

British Columbia

T. N. Showring
Industrial Supplies, Ltd.
Publicity Chairman

MARCH 22 MEETING was attended by some 45 members and guests, who met at the Vancouver Vocational Institute to hear J. A. Gitzen, Delta Oil Products Co., Milwaukee, speak on *"The Causes of Core Failures."*

Mr. Gitzen started his talk with a description of the origin and development of the various types of cores and binders in common use in industry and went on to discuss the merits and applications of each.

Reasons for many common core failures were explained in detail by Mr. Gitzen, who said that one of the chief causes of core failures is insufficient baking, which leaves core centers relatively green. He concluded by using graphs to illustrate the amount of baking time necessary to insure that the moisture is entirely removed from the cores.

Central Indiana

Paul V. Faulk
Electric Steel Castings Co.
Chapter Reporter

APRIL 2 MEETING featured a talk by L. W. Eastwood, Battelle Memorial Institute, Columbus, Ohio, on *"Unsoundness in Castings and the Role of Gas Evolution,"* in which he discussed castings unsoundness produced by the evolution of two types of gas during solidification of non-ferrous metals.

Mr. Eastwood covered both the atomic and molecular forms of gas and told how they progressively produce harmful effects during solidification. An interesting question and answer period on gases and non-ferrous metals followed Mr. Eastwood's talk.

Nominating Committee Chairman Franklin Swain, Golden Foundry Co., Columbus, Ind., announced the committee's selection and called for any additional nominations to be presented in writing to the chapter secretary. Concluding the meeting was a report of the building fund committee.

Cupola operation was the subject discussed by Lyle D. Clark of Buick Motor Division, GMC, at Eastern New York Chapter's February 20 meeting, Lathams, N. Y.

Lucky winner of an electric shaver in Oregon Chapter's monthly raffle to raise funds for the A.F.S. Permanent Home was Rolly Topping, Electric Steel Foundry Co., right, shown accepting his prize from Chapter Chairman James T. Brodigan, Columbia Steel Castings, Inc., at the chapter's March meeting. (Photo courtesy Dar Johnson, Electric Steel Foundry Co.)

Eastern Canada

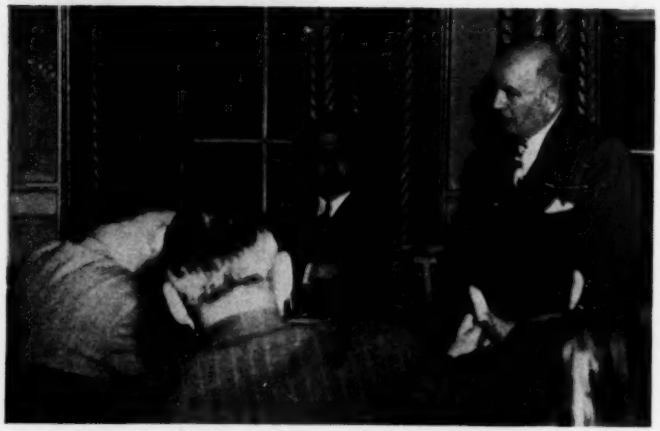
M. G. McQuiggan
Canadian Foundry Supplies & Equipment
Chapter Reporter

MARCH 9 the chapter was host to Canada's A.F.S. National Director, J. J. McFadyen, Galt Malleable Iron Co., Galt, Ont. Mr. McFadyen, as spokesman for the National Office outlined the many activities and projects now being undertaken by the Society.

Following Mr. McFadyen's talk, Chapter Chairman Lucien Guilmette presented a check on behalf of the Chapter for the A.F.S. Building Fund to Past National Director E. N. Delahunt, Warden King, Ltd., Montreal, who is Canada's representative on the Building Fund Committee.

In thanking the chapter for the donation, Mr. Delahunt reported progress of the Fund to date and suggested that those members who wished

Foundry bull session at Eastern New York Chapter's March 20 meeting included, left to right: A. J. Kiessler, General Electric Co.; A.F.S. National Director E. C. Troy, Palmyra, N. J., speaker; Leigh Townley, Adirondack Foundries; and Chairman Leo M. Scully, Scully Fdy. & Machine Co.



Franz Schumacher, Cooper Alloy Foundry Co., Hillside, N. J., speaking on metal coating of patterns at Toledo Chapter's March 7 meeting, held at the Toledo Yacht Club. (Photo by R. C. Van Hellen of Unitcast Corp.)

to make individual contributions to the Fund do so through him.

S. L. Gertsman, Bureau of Mines and Technical Surveys, Ottawa, Ont., was the evening's technical speaker and gave an excellent talk on *"Metal Penetration,"* in which he used slides to illustrate various degrees of metal penetration, defining them as either "burn-on" or "penetration."

Reporting on investigations carried on under his direction, Mr. Gertsman said temperature of poured metal and pressures exerted by casting bulk, riser and sprue heights are governing factors in the breakdown of mold-metal interface. The importance of careful selection of grain size in sand and the addition of either silica flour, wood flour or iron oxide were thoroughly explained by Mr. Gertsman.

Western New York

Marve Taublieb
Frederic B. Stevens, Inc.
Publicity Chairman

AT ITS MARCH MEETING the chapter had the pleasure of entertaining seven Danish foundrymen, members of a team visiting foundries in this country under the auspices of the Economic Cooperation Administration. In charge of the group was N. C. Philpott of ECA, who said "These men are here under the Marshall Plan to learn how to increase their foundry production. It is their desire to reduce costs, increase production and improve their country's standard of living."

Following Mr. Philpotts' introductory speech, A.F.S. National Secretary-Treasurer Wm. W. Maloney outlined the program for the 55th A.F.S. Foundry Congress and, commenting on the immediate future of the castings industry, said that there will be an increased need for quality and that plants must be surveyed to find how they can best increase production.

It is necessary, Mr. Maloney stated,

St. Louis District Chapter Chairman John Williamson, M. A. Bell Co., makes a few announcements at the March 8 meeting. Looking on, from left, are: Technical Chairman Fred Zinzer, American Steel Foundries; Vice-Chairman Ralph M. Hill, East St. Louis Casting Co.; Speaker R. L. McIlvaine, National Engineering Co.; Chicago; and Secretary Paul E. Retzlaff, Busch-Sulzer Bros. Diesel Engine Div. Nordberg Mfg. Co.

that the foundry industry begin training new personnel, find a steady labor supply, and train foremen in labor-management relations.

As an example, Mr. Maloney said, employees should be encouraged to benefit from round table discussions and shop courses presented at the Foundry Congress. He suggested that companies require reports from men attending the Convention so that upon their return to their plants, open discussions can be held on information learned.

Evening's technical speaker was J. B. Caine, foundry consultant, Wyoming, Ohio, who discussed *"Gates and Risers."* Primary function of gates, he said, is to deliver metal to the mold with the least disruption of the sand.

In explaining the principles of hydraulics, Mr. Caine pointed out that the principal difficulty in their use is human failure such as soft ramming, mixed matchplates, and using old gate sticks, causing tear-ups.

Erosion in the gates, Mr. Caine said, is the primary reason for sand in the casting. Until ramming improves and discontinuous flow of metal over a flat surface is eliminated, foundrymen cannot hope to improve castings, he added. Mr. Caine suggested tilting the mold to improve the flow of metal, but said that this is difficult, if not impossible, in a production plant.

The speaker pointed out that riser sections must be larger than casting sections unless exothermic material is used. An incorrect riser contact with the casting, he said, is the outstanding cause of rejection of castings because of shrinkage.

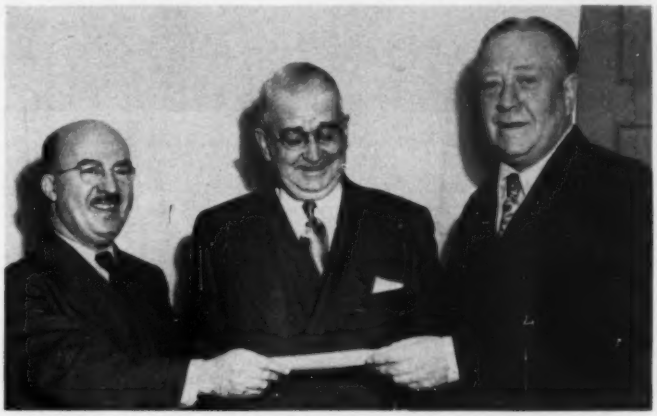
Mr. Caine concluded by saying the principles outlined in his talk were primarily for steel castings, but fundamentally they applied to other metals as well. A sound casting with a maximum yield, he ended, is the aim of every foundry.

Evening's technical chairman was Joseph Sander, Tonawanda Electric Steel Casting Corp. Chapter Chairman A. A. Diebold, Atlas Steel Casting Company, Buffalo, presided.

On March 1 members of the A.F.S. National Office staff—Secretary-Treasurer Wm. W. Maloney, Technical Director S. C. Massari and Convention and Exhibits Manager A. A. Hilbron—met with chapter officers and directors to discuss duties of the Host Chapter at the 55th Foundry Congress. Western New York chapter officers and directors present included Chairman A. A. Diebold, Atlas Steel Casting Co.; Vice-Chairman Erwin Deutschlander, Worthington Pump & Machinery Corp.; Secretary Roger E. Walsh, Hickman, Williams & Co., Inc.

Directors Walter D. Hunsicker, Wor-

Photographed at Quad City Chapter's March 9 meeting were, left to right, A.F.S. National Secretary-Treasurer W. W. Maloney, A.F.S. Technical Director S. C. Massari, Chapter Chairman H. A. Rasmussen, General Pattern Corp., and National Director F. W. Shipley, Caterpillar Tractor Co.



Chapter chairman L. Guilmette, left, Canadian Foundry Supplies & Equipment, Ltd., presents a check for Eastern Canada Chapter's donation to the American Foundrymen's Society Building Fund to Past National Director E. N. Delahunt, Warden King, Ltd., right, as A.F.S. National Director J. J. McFadyen, Galt Malleable Iron Co., Galt, Ontario, looks on.

Central Indiana foundrymen line up for the chance to donate to the A.F.S. Building Fund at the March 5 meeting. Accepting contributions (center, smoking cigarette) is William B. Ziegelmueller, Electric Steel Castings Co., Indianapolis, fund raising committee chairman. Photograph courtesy Henry Yeager, staff photographer, International Harvester Co.

Sparking Tennessee Chapter's February 23 meeting were, left to right: Chapter Chairman Paul L. Arnold, U. S. Pipe & Foundry Co.; Frank Robbins, Jr., Robbins & Bohr, Inc.; Speaker J. M. Kane, American Air Filter Co., Louisville; and National Secretary-Treasurer Wm. W. Maloney.

thington Pump & Machinery Corp.; George A. Knowles, Geo. A. Knowles Foundry, Inc.; Henry F. Sproull, A. P. Green Fire Brick Co.; John R. Wark, Wark Foundry Supply Co.; Robert Bruce, Buflovak Div., Blaw-Knox Co.; Robert D. Young, Lumen Bearing Co.; Joseph M. Clifford, Bison Castings, Inc.; W. H. Oliver, American Radiator & Standard Sanitary Corp.; Joseph H. Sander, Tonawanda Electric Steel Casting Co.

Convention committee chairmen present were: Leo A. Merryman, American Radiator & Standard Sanitary Corp.; Otto A. Guenther, New York State School of Applied Arts & Sciences; Frank E. Bates, Worthington Pump & Machinery Corp.; Joseph Zahm, Master Pneumatic Tool Co.; Lynford C. Roberts, Combined Supply & Equipment Co.; and H. Ward Stewart, Jr., secretary-manager, Buffalo Convention & Tourist Bureau.

Northwestern Pennsylvania

Earl M. Strick
Erie Malleable Iron Co.
Chapter Secretary

ON MARCH 16, members and guests visited United Engineering Co.'s steel foundry, Erie, in the afternoon and after a dinner in the plant cafeteria heard Harold Johnson, National Malleable & Steel Castings Co., speak on *"Statistical Control in the Foundry."*

This new tool, which according to Mr. Johnson, is not a two-dollar word for inspection, has been put into operation in the several National Malleable plants and has not only given the company a measuring stick for the quality of its materials, operations and products, but has speeded flow of materials. After variations are tabulated and standards set, Mr. Johnson said, a check of quality control charts shows immediately where corrections are needed in the foundry.

Immediate action is a necessity when "off-color" variables appear on the charts, the speaker said, adding that the charts are not a cure-all but are rather a measurement stick of the efficiency of a foundry.

Delegations from Erie, Franklin, Grove City, Meadville, Butler and Sharon, Pa., were present. Co-chairmen for the meeting were Mark Baatz, United Engineering and Foundry Co., and Henry McKinney, Butler Engine Co. Program Chairman Douglas James, Cooper-Bessemer Corp., arranged the March meeting.

March 26 meeting was held at the Moose Club, Erie, where 75 members heard a coffee talk by O. Carlyle Brock, president of Erie Standard Products Co., and a big-game hunter.

Mr. Brock told of a recent trip to Central Africa, where he shot elephants, lions, tigers and other big game. Mr. Brock then went on to illustrate several startling likenesses between animals and men.

Technical speaker for the evening was Bruce Norris, Allis-Chalmers Mfg. Co., Milwaukee, who discussed *"Modern Aspects of Radiography in the Foundry."* This method of inspection, he said, is a great help to foundrymen in the production of better castings.

Mr. Norris outlined a brief history of radiography and told of various methods of using radium and cobalt in non-destructive testing. Radiographic inspection, he predicted, will soon be a standard foundry tool and said that development of the betatron

(Continued on Page 108)

A.F.S. notables attending Central Illinois Chapter's March 5 meeting included, seated, left to right: A.F.S. National President Walton L. Woody, A.F.S. National Director Frank W. Shipley, Caterpillar Tractor Co., Peoria, Ill.; and A.F.S. National Secretary-Treasurer Wm. W. Maloney. Standing, left to right, are Chapter Vice-Chairman Robert Dickison, Brass Foundry Co., Peoria; Speaker Frank S. Brewster, Harry W. Dietert Co., Detroit; Chapter Chairman C. W. Russell, Caterpillar Tractor Co.

. . . dozens of man-hours— by a few minutes of Radiography

THERE'S a lot of skilled machinist time invested between a cast bronze blank and a finished precision gear. And it's time all lost when you wait until the cutting tool exposes a gas hole or other irregularity in the casting causing rejection.

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LETTERS TO THE EDITOR

Band Filing Casting Fins

Since reading H. J. Chamberland's paper; *"Continuous Filing as Applied to Castings"* (AMERICAN FOUNDRYMAN), December 1950, page 37), I've been wondering what effect fins on gray iron castings would have on rate of metal removal and on file band life. Because of their small section and rapid cooling, fins are white or at least very hard. I have not used band filing on castings but have used it on annealed tool steel with substantial savings in cost without sacrificing accuracy.

RICHARD J. WOLF, *Engineer*
Stone & Webster Engineering Corp.
Boston, Mass.

Since the size of the fin and the composition of the metal control the hardness there are times when it is advisable to remove the fins by friction sawing or conventional sawing. It is then possible to follow up with band filing to get a smooth accurate finish.

H. J. CHAMBERLAND, *Field Res. Eng.*
DoALL Co.
Springfield, Mass.

Fundamentals — Pro and Con

The following letters and author's reply have been received in response to the publication of "Foundry Sand—Getting Down to Fundamentals," by Clifford E. Wenninger, director of foundry research, University of Kentucky, which appeared in the January 1951 issue of AMERICAN FOUNDRYMAN, *page 45.*

This article puts in plain language an argument which I have been trying to formulate for some years.

B. RICHARDSON, *Met. Res. Eng.*
Steel Castings Institute of Canada
Toronto, Canada.

We wish to congratulate Mr. Wenninger on a most interesting article and feel certain it will prove valuable to the industry.

W. H. SHUTT
York Corp.
York, Pa.

It seems that the content of this paper does not justify such an ambiguous title as *"Getting Down to Fundamentals"*. From this title the reader can expect that the data presented in this paper should permit one to put sand research on the fundamental basis. But what fundamentals are advanced in this paper? Possibly the dip test would be the answer to this question. With the development of the dip test, the author says, "industry got back on the road to fundamental knowledge."

It is realized fully by writer that Caine's dip test as well as other similar methods,[1] where sand specimens are brought into intimate contact with the molten metals at different temperatures, are of great importance. However, it is not clear how these tests are getting us on the road to fundamental knowledge.

Fundamental knowledge is based on data which permit one to predict different phenomena. For instance, the development of the constitution diagrams of different metal systems, showing a definite relation between composition, temperature and structure, is fundamental and permit one to predict different physical properties of alloys. Research of this type is presented in the work of R. E. Savage and H. F. Taylor[2] in their recent study of the mold-metal interface reactions by the use of phase diagrams and x-ray diffraction analyses. It is believed also that a study of foundry sands using the petrographic microscope would be of interest to the industry. These, in the writer's opinion, are examples of basic research.

At the beginning of the paper it is stated: "It may be surprising to many foundrymen to find that the foundry industry chose the wrong road in the development of foundry sand control, that we are just about where we started from some years ago, and that it remains for the industry to travel a new road if it desires to place foundry sand control on a firm scientific basis."

It is surprising indeed that this and other similar statements are offered to the reader without supporting them with substantial data. What is the wrong road and what is the new road which would place foundry sand research on a firm scientific basis? Does it really mean that the numerous investigations conducted on fineness, permeability or compression strength of different sands have led the industry on the wrong road and should be abandoned?

Foundry sand control is the youngest branch of research in the field of foundry metallurgy. In spite of its short history one can only admire the fact that foundry sand research, particularly during the last decade has made such splendid progress. Such achievements as the development of dilatometer for testing different properties of foundry sands at elevated temperatures, the introduction of the hydrometer method for the determination of fineness, or an application of the phase diagrams and x-ray diffraction analysis in studying the mold-metal interface reactions seem to indicate that sand research is still marching on the right road and is progressing rapidly, with new and more precise apparatus and methods of measurements being developed.

(In this connection the writer wishes to call the reader's attention to the recent paper on "Methods of Sieve Analysis with Particular Reference to Bone Char," by Frank G. Carpenter and Victor R. Dietz, Research Paper 2143, *Journal of Research of the National Bureau of Standards*, vol. 45, no. 4, October 1950. It is well known that the sieve analysis is the principal test for measuring the particle size of different powdered and granulated materials. The sources of errors in a sieve analysis are: the sieves, the method of shaking, and the sample. It was found that the largest source of error is in the testing sieves themselves. In this excellent paper a method is recommended to determine uniformity of sieve openings.)

It is true that sand research is still an art and is based on empirical knowledge but it is also true that only through accumulated knowledge based on a great number of precise observations can we draw at least tentative deductions. It is sometimes found that a tentatively accepted theory is incorrect or that it needs further improvement. The example cited by the author concerning the postulated effect of moisture on scabbing may illustrate this point. It is now quite obvious, in the light of recent experiments, that there are other factors besides moisture which may be responsible for scabbed castings.

The writer is, of course, in full agreement with the author that "it is essential that the disease (scabs) be studied and defined in detail before one attempts to prescribe the proper preventive medicine (sand control measures)." He also hopes that before long more information will be available on this subject. There is no doubt that such methods as Caine's dip test, Gertsman and Murton's method of testing metal penetration, Moore's hot toughness test,[3] and Savage and Taylor's scientific analysis will prove useful tools in the true solution of this problem.

References

1. S. L. Gertsman and A. E. Murton, "An Investigation of Metal Penetration in Steel Sand Cores," A.F.S. TRANSACTIONS, vol. 58, pp. 595-603 (1950).
2. Robert E. Savage and Howard F. Taylor, "Fayalite Reaction in Sand Molds used for Making Steel Castings," A.F.S. TRANSACTIONS, vol. 58, pp. 564-577 (1950).
3. W. H. Moore, "New Sand Testing Method," *Foundry*, vol. 79, no. 1, January 1951, pp. 152, 154, 176, 178.

A. I. KRYNITSKY
Chevy Chase, Md.

Mr. Wenninger's interesting and provocative article has undoubtedly caused a considerable amount of discussion among sand researchers and sand control men. He suggests that we stop and analyze our thinking on sand and see if we are going in the right direction. He says, "It may be surprising to many foundrymen to find that the foundry industry chose the wrong road in the development of foundry sand control." He states that it is wrong to proceed entirely on empirical knowledge, and it is preferable to use fundamental knowledge. The Caine dip test is suggested as "the most recent, and most effective, contribution in getting down to fundamentals."

Before entering upon a discussion of this subject, I would follow Voltaire's advice, "if you would converse with me, define your terms." According to Webster's dictionary the definition of our terms are—art: a system of rules and established methods to facilitate the performance of certain actions; empirical: pertaining to, founded upon or derived from, experience; fundamental: pertaining to a foundation or basis (adjective), a primary or essential principle (noun);

(Continued on Page 117)

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CHAPTER ACTIVITIES

(Continued from Page 104)

by Allis-Chalmers Mfg. Co. has proved a great advance in this field.

Roy Zimmerman, chief inspector, General Electric Co., led the discussion and showed several slides of castings x-rayed by his company.

Oregon

J. A. Larkin
Electric Steel Foundry Co.
Chapter Reporter

SPEAKER at the February meeting was R. M. Ronne of the Dependable Pattern Works, Portland, whose subject, *"Modern Pattern Rigging,"* was limited to discussion of coreboxes and use of core blowers.

Mr. Ronne stated that foundries in this area were slow to accept coreblowers as a means to improve production and quality of castings and even now they are not usihg machines to their best advantage.

R. M. Ronne, Dependable Pattern Works, Portland, Ore., speaking on modern pattern rigging at Oregon Chapter's February meeting. (Photograph by Norman Hall of Electric Steel Foundry Company.)

Factors to consider when buying coreblowers, he said, are: quantities to be made; maximum size core that can be made in the machine; utilization of the full capacity of the machine (*i.e.*, don't make a single box if a 3-gang box can be blown in the machine); have core box made so that small quantities can be hand rammed; make provisions for wires in core where necessary; and make dryer plates to fit top half of core box to make it possible to blow the core right into the dryer plate.

Some suggestions made by Mr. Ronne to the owners of coreblowers

were: assign one man to blower and let him become a specialist in operating and maintaining equipment; always keep boxes clean—dirty boxes cause more difficulty in blowing cores than any other factor; make use of automatic draw feature of the machine for greater economy (if the machine draws too slowly, open valve to let the air out of the chamber more rapidly); core boxes must be light but strong to resist abrasion and the pressure of the machine, therefore use aluminum or magnesium boxes with steel faces.

Two motion picture films were shown at the meeting on the use of chaplets and chills in large Eastern foundries. The films are produced by the Fanner Manufacturing Co.

The nominating committee for new officers of the Oregon Chapter was named by Chairman James T. Brodigan. Members are: George C. Vann, Northwest Foundry & Furnace Co., chairman; William M. Halverson, Electric Steel Foundry Co.; Henry C. Weiss, Mobilift Corp.; Loren E. Beardsley, Crawford and Doherty Foundry; George E. Battin, Northwest Pattern Works; James L. Henderson, Rich Mfg. Co. of California; Tony Belusko, Electric Steel Foundry Co.

Membership Chairman Loren Bacon introduced new member Sylvester Krukowski, Electric Steel Foundry Co.

Eastern New York

George S. Danner
American Locomotive Co.
Publicity Chairman

MARCH MEETING, held at Circle Inn,

Proper use of sand additives was the topic of a talk by J. A. Gitzen, Delta Oil Products Co., Milwaukee, at Southern California Chapter's March meeting. (Photograph courtesy of Kenneth F. Sheckler, Calmo Engineering Co.)

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NATIONAL BENTONITE

It doesn't take a detective to find out that National Bentonite helps foundrymen make better molds. A great many expert foundrymen have used National Bentonite regularly for years to insure molds with high strength both green and hot, with minimum moisture content. This last point is important, since it means much less chance of gas holes and blows. Molds made with National Bentonite also yield castings with finer finish—and that's often important, too.

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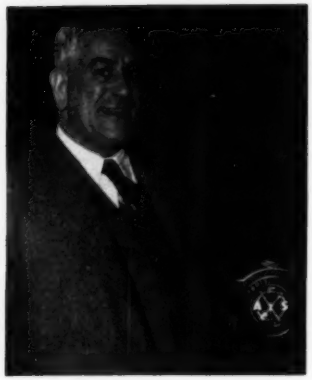


Winner of a set of cast book ends for longest-time membership in A.F.S. at Detroit Chapter's Old Timers and Apprentices Night was Claude B. Schneible, president, Claude B. Schneible Co., Detroit (Photograph courtesy of Walter Ring, Cadillac Motor Div., GMC).

Lathams, N. Y., had as its principal speaker E. C. Troy, Palmyra, N. J., foundry consultant, who discussed "*Steel Foundry Practice.*" Mr. Troy is an A.F.S. National Director.

Mr. Troy's talk was less of a technical nature than a discussion of the changes that have taken place in the foundry industry in the last 20 years.

He described the foreman of 20 years ago as "the man who could outswear any other man in his foundry," and the metallurgist as a "green kid or office boy who was never told the mystic rituals necessary to make good castings." This lack of knowledge on the part of supervision, he said, gave rise to quack methods.

Since that time, Mr. Troy said, the industry has come a long way. Among the major developments he cited as taking place in the last two decades were:

Sims and Dahle's solution of the pinhole problem by adding aluminum to the melt in 1938.

Development of carbon analysis, slag control and the acid process of eliminating hot tears and low ductility in the years of 1939 to 1941.

The work of John Williams in making for a better understanding of how to overcome shrinkage problems, and development of the blind riser.

Gradual accumulation of knowledge in controlling sands and the development of stronger sands.

According to the speaker, less tangible but nevertheless contributory to

(Continued on Page 115).

ABSTRACTS

Abstracts below have been prepared by RESEARCH INFORMATION SERVICE of The John Crerar Library from current American and foreign literature. For literature searches and translations of technical, industrial, and scientific literature, and photostats and microfilm, write to: Research Information Service, The John Crerar Library, 86 East Randolph Street, Chicago 1, Illinois. Rates for above services given on request.

Lead Bronze Components

A121—Strength and Anti-Friction Properties. A. Rühenbeck, "The Influence of Sulphur and Iron on Binary Lead Bronze," *Giesserei*, vol. 38, Mar. 8, 1951, pp. 103-106.

An experimental investigation of the influence of sulphur on the structural development and hardness of binary lead bronze, led to the conclusion that the sulphur content required for the most favorable distribution of the lead is a function of the lead content of the lead bronze (Pb:S=100:1). Concerning the influence of iron, it was found that when iron was added to exceed the solubility limit in copper, the result was a globular and especially fine-grained lead bronze structure. This was due to the high surface tension of the iron. Such a globular lead bronze has better strength and anti-friction properties than the usual commercial varieties of lead bronze. The limit of solubility is influenced by the presence of other metals, insofar as they form mixed crystals with the copper. The addition of sulphur does not change the solubility limit, because the sulphur is present in the structure in the form of lead sulphide.

European Sand Binders

A122—New Materials and Methods. E. Westerling, "Air-hardening Moulding and Core Sands," *Gjuteriet*, vol. 40, Dec. 1950, pp. 203-207.

A short review of the air-hardening binders used in Continental European foundries is presented by the author. The modern cement-sand technique is described and its advantages and disadvantages are enumerated. Some of the more commonly used Dutch and German air-hardening oil binders are discussed. Some oil-cereal-bentonite bonded steel foundry sands for dry sand work which do not require drying are also reviewed.

Measure Surface Roughness on Steel Castings

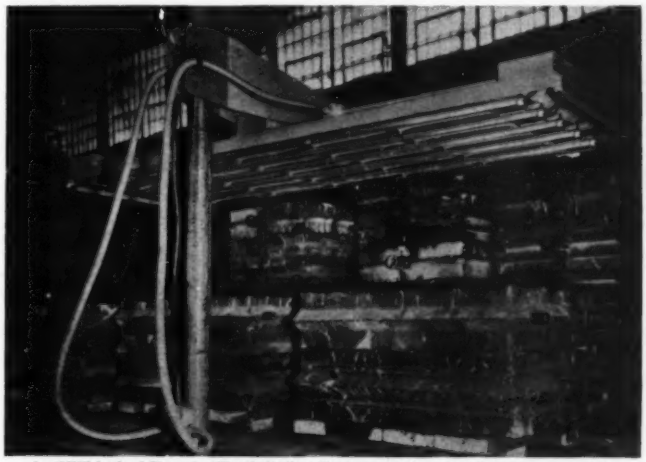
A123—Sand-Metal Interface Conditions. P. R. Beeley and H. T. Protheroe, "The Adherence of Sand on Steel Castings," *Journal of the Iron and Steel Institute*, vol. 167, Feb. 1951, pp. 141-156.

The authors discuss methods employed for the visual comparison of the degree of roughness on steel castings, and for the numerical assessment of penetration. A relationship has been established between metal penetration and sand adherence. Conditions at the sand-metal interface were investigated, and an explanation of the mechanism of adherence is presented. The effect of varying the bond of the sand was also investigated. The relative merits of various mold paints have been determined.

Iron "Spark" Analysis

A124—Oxidation Process. E. J. Kohlmeyer, "Iron Sparks During the Process of Bessemerizing in a Small Converter," *Giesserei*, vol. 38, Feb. 22, 1951, pp. 73-76.

Photographs were taken of the sparks observed during the bessemerizing of crude iron (with 4.3 per cent C) heated in a crucible surrounded by a high-frequency coil. From the analysis of the spark pictures it was found that at 1500 C and at atmospheric pressure there occurred considerable gasification of iron in the form of an unstable complex with a composition approximately the same as iron carboxide, which after being released from the furnace decomposed into iron and carbon monoxide. The effect was the same regardless of whether the necessary oxygen was supplied directly or in the form of ferric oxide. If air was excluded during the process of gasification, the oxidation of the iron carboxide complex was prevented, and the gasified iron could be obtained in the form of a fine powder.



An 18KW bank of Chromalox Electric Radiant Heaters mounted over a roller conveyor is used for efficiently skin drying molds in this installation. The bank of heaters, 7½ ft. long by 1½ ft. wide, is adjustable in height for varying mold sizes. Molds are skin dried in 15 minutes.

Infrared Heat Improves Skin Drying of Molds

Minneapolis, Minn.—A modern installation of Electric Infrared Heaters has replaced the old fashioned, conventional method of using a flame torch for skin drying molds in this Minneapolis foundry. Five 3600W Chromalox Electric Radiant Heaters mounted together in an angle-iron frame are suspended over the molds placed on the roller conveyor. The heaters are easily lowered or raised to accommodate the various heights of molds being skin dried in the foundry.

After the molds are moved into position, the heaters are turned on and left unattended for the 15-minute skin drying operation. The man who formerly operated the torch is free for other duties during the drying cycle. After drying, the molds are withdrawn, as needed, for the closing operation. The heaters may be turned off when not in use.

The all-metal infrared heaters are not damaged by rough handling in the foundry. Accidental blows or contact with the molds will not affect the heaters. The uniform radiation from the heaters evenly heats the entire mold. The former over-heating of sharp corners and projections in the molds is eliminated.

The working conditions were improved by the installation since the heat generated is confined to the molds and not spread throughout the shop. The elimination of the objectional fumes from the torch flame further improved the working comfort.

In this same foundry, small miscellaneous molds are skin dried with a portable bank of similar Chromalox Radiant Heaters. The drying of deep cavity ladles is also modernized with electric heat.

MORE INFORMATION

Further data on this and other efficient applications of Chromalox Electric Radiant Heaters is available on request from: EDWIN L. WIEGAND COMPANY, 7609 Thomas Blvd., Pittsburgh 8, Pa. 80-22

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Bag-Type Dust Suppressor

1—High efficiency of the Whiting Bag-Type Suppressor in suppressing dust, fumes and smoke makes it possible to meet stringent regulations governing foundry cupolas, metallurgical furnaces and other sources of dust in hot gases. Used in foundry cupolas, the Whiting

Suppressor removes all gases from the top of the cupola stack and suppresses more than 95 per cent of the solids, including particulate matter of micron and submicron size. The Whiting Suppressor collects all gases from the stack, cools them to an appropriate temperature and then filters out virtually all particulate matter with a bag-type filter. Automatic controls and protective devices are furnished to assure continuous operating efficiency and equipment safety. Suppressor is the first equipment for an iron foundry to receive an operating permit from the Los Angeles County Air Pollution Control District. *Whiting Corporation.*

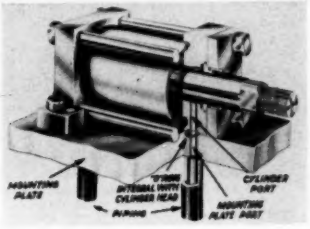
Saw Guide

2—Portable Skilsaw guide converts a portable electric saw into a portable

radial saw in a matter of seconds, permitting on-the-job precision saw cuts. Weighing 26 lb, guide is easily attached to a small platform on two saw horses. With rapid adjustments, cross-cuts, bevel cross-cuts, miters, bevel-miters, rips and bevel-rips are easily and safely made. Gang-cutting and preforming become simple and precise operations. Made for use with Skilsaw Models 77, 825, 87 and others with a base width capacity of 4-13/16 to 5-¼ in., guide has a radial range of 120 degrees (60 degrees right or left) and a bevel capacity of 45 degrees. Maximum cut-off capacity is 17 in. and maximum ripping width is 28 in. *Skilsaw, Inc.*

Cylinder Mounting

3—Ingenious new "O" ring cylinder mounting permits rapid, easy installation of air and hydraulic cylinders singly or in space saving, side-by-side manifold mounting without need for making actual



pipe connections to cylinders. Piping is directly connected to ports in a machined flat-surfaced mounting plate or manifold and cylinders are mounted on plate with their ports mating in perfect alignment with mounting plate ports. "O" ring seals at mating surfaces of cylinder ports assure leakproof seal under pressure and suction. Advantages are: greater and smoother hydraulic fluid flow and elimination of turbulence and aeration. *Miller Motor Co.*

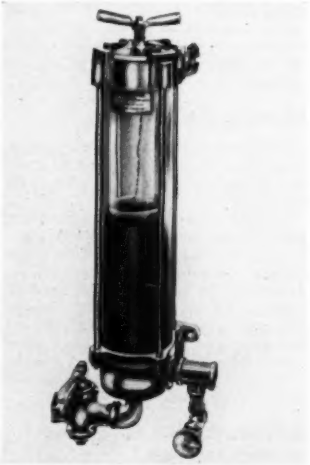
Drying Oven

4—Car-type core and mold drying oven has free loading space 15'6" wide x 31'0" long x 9'0" high. Cores and molds

are transported in and out of oven by flanged wheel cars running on rails on floor. Each of two cars has 15' sq loading platform and cars can be combined to form single large platform. With normal load of 50 tons of large cores, 450 F air temperature control point is reached in 1½ hrs from cold start and cores are fully baked seven hours after. Features: Generous heater capacity combined with high volume air circulation; uniform baking—no hot side or cold side to oven. Gas-fired heat and recirculating system is mounted on roof of oven and built as an extension to oven walls, eliminating need for external duct work and permitting ready accessibility to fans and burner for inspection. *Michigan Oven Co.*

Wetting Compound Blender

5—Simple and inexpensive to operate, the Hydroblender automatically mixes ordinary water with Aquadyne Multiphase Wetting Compound to produce "wet water" at less than ½¢ a gallon for effective foundry dust control without elab-



orate equipment. In sand conditioning, a small amount of wet water improves workability and uniformity of the molding mix. *Aquadyne Corporation.*

Radial Arm Saw

6—Model 40-B radial arm saw features full capacity to make cuts at any angle from 0 to 90 degrees right and left above working table, and double 360 degree

radial action permits adjusting saw to lumber instead of lumber to saw. Other features are: automatic locating latches at 0, 30, 45, 60 and 90 degrees; totally-enclosed fiberglas-insulated, direct-drive motor; lifetime trackways, pivot-point slide that keeps saw kerf above worktop; and safety guard with splitter having kickback fingers. Saw is available in three types—(1) portable, with hand grips, (2) mobile, mounted on rubber-tired trailer, and (3) stationary, mounted on cabinet-type base. Models are available in several sizes: ¼-5 hp, 1 phase a-c, ¼-7½ hp, 3-phase a-c. *Delta Power Tool Div., Rockwell Mfg. Co.*

Oil and Grease Absorbent

7—Acco-Dri, a dust-free granular absorbent for oil and grease, has the sponge-like property of holding a large quantity of liquid per unit of weight and is not affected by heat or cold. Acco-Dri is a fireproof, non-metallic compound that is non-injurious to health, is harmless to hands, face, clothing or shoes and will not stain or mar concrete, metal, wood or painted surfaces. Recommended by manufacturer as a safety measure to prevent slipping in or about machinery or in aisles and passageways where emulsified water (soluble oil) or grease are present. Non-muddable characteristics make it ideal for maintaining safe footing. Acco-Dri is available in full carlots or in split carlots with southern bentonite and may be stored indefinitely under cover without deterioration. *American Colloid Co.*

Speed Bridge Thermometer

8—Universal Speed Bridge is a self-contained, portable electronic thermometer pyrometer that covers temperatures from -200 C to 1600 C or the equivalent in fahrenheit, using two types of bulbs. A great variety of other bulbs are available to meet any laboratory or industrial requirements. Ranges are changed by exchanging two plugs containing bridge arms or by operating two toggle switches. Steel case 12 x 17 x 8 in. encloses bridge, power supply and electronic null indicator. Unit can be plugged into any 115 volt, 60 cycle line. Manufacturer claims accuracy is approximately 0.1 degree over entire scale because of 10-turn geared dial that makes 1000 divisions available. *Weiller Instruments Corporation.*

Dust Precipitators

9—Bulletin 1728 contains well-illustrated pages and factual information on dust precipitators designed to handle fly ash, cinders and industrial dusts. Series 342 precipitators are built in a range of standard sizes with two basic arrangements and can be modified to fit special requirements. Unique design of unit simplifies field erection and unit can be shipped to factory in assembled, match-marked sections. *American Blower Corp.*

Power Boiler Conditioner

10—Agava Power Boiler Conditioner is a safe colloidal organic compound that prevents rust and corrosion and removes impurities, oils and scale from boilers. Operating on a physical principle rather than a chemical one, Agava effectively disintegrates scale so that it can be removed by draining; and holds heat-preventing oils in solution and does not permit them to adhere to boiler or piping surfaces or form surface film. Agava is harmless to skin and clothing and to rubber, gaskets, etc. *Agava Products, Inc.*

Threaded Flask Pins

11—Universal threaded series flask pins and bushings are designed for use in steel, aluminum, magnesium or other light metal flasks and are precision machined, hardened and ground for lasting accuracy. Once installed, they maintain stability and accuracy to provide register of cope and drag for hundreds of castings. Bushings are available in both round and elongated types; pins in round and hexagonal types, and are interchangeable with original equipment of most flask manufacturers using similar pins and bushings. Complete line of sizes is available. *Universal Engineering Company.*

Dry Hardness Tester

12—No. 673 Dry Hardness Tester provides for rotary hardness to make core hardness measurement easier and more certain. Tester is pressed flat on core, knife is rotated 90 degrees, and hardness is read from dial. Pointer does not waver and reading is clearly indicated on simple 0 to 100 circular dial. No calculations or reference to tables are necessary. A group of sand grains are dislodged during the test so that an average hardness is obtained. Instrument will also read scratch and indentation hardness. *Harry W. Dietert Company.*

Fire Detection System

13—Fireye, a basic new development in fire detection, actually "sees" fire and does not depend on heat, smoke or other indications of fire. Operating on a photo-electric principle, Fireye System FD-10 Protection Block consists of six detectors and one control panel, providing coverage up to 10,000 sq ft, with each detector monitoring a 20 ft sq area. Unique self-monitoring feature assures that equipment is in constant readiness to detect fire. An electrical impulse of sufficiently low intensity to prevent fire alarm is continuously applied through all circuits. Loss of this signal due to wiring or component failure actuates a relay to give a distinctive trouble warning. Capable of detecting a very small fire, Fireye is designed to ignore extraneous light of any

(Continued on Page 123)

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Testing Machines

14—Eight-page folder illustrates current Amsler machines for tests in tension, compression, torsion, shear, fatigue, bending and ductility. Bulletins are also available on wear testing and testing of miniature samples. *Adolph I. Buehler.*

Gage Blocks

15—Of interest to patternmaking and permanent mold shops is a folder containing price lists and detailed data on heavy duty gage blocks and fixtures, carbide gage blocks and a new and improved method of angle inspection. *The Webber Gage Company.*

Railway Car Handler

16—Dramatic picture story on the new Trackmobile, a jeep-sized plant "locomotive," is offered in Bulletin TM-101. Trackmobile weighs only 6000 lb., yet develops draw bar pull of 7350 lb, equal to that of conventional plant locomotives, and operates either on track or on the ground. Equipped with two sets of wheels —one for track travel and the other for ground travel—the Trackmobile changes from track to ground operation in less than 30 seconds, thus preventing its becoming bottled-up after completing a hauling job. Rated to pull a load of 200 tons, the Trackmobile has a variety of potential applications, which are described in the bulletin. *Whiting Corp.*

Abrasive Products

17—As described in Bulletin 30M-11-46, Bay State abrasive products, including straight wheels, flaring or straight cups, saucers, cylinders and segments, are claimed by manufacturer to increase production through fast cutting, reduce regrinds and minimize burning, and lengthen tool life between grinds. Bay State grinding wheels and segments are made by the Koolpore Process, which features honeycombing with thousands of induced pores, allowing for extra chip clearance, faster stock removal and faster cutting action. *Bay State Abrasive Products Co.*

Castable Super-Refractory

18—Four-page Bulletin 313 outlines physical properties and various applications of Tasil Hydrocast, a castable superrefractory for use in casting special shapes, crucible furnaces or melting aluminum, furnace door linings, cyanide furnaces, salt bath furnaces, heat-treating furnaces, etc. Advantages claimed by manufacturer for this hydraulic-setting refractory that pours in place like concrete are: ease and low cost of construction, high refractoriness, ample hot strength, low shrinkage, freedom from spalling and high insulating value. Booklet describes grain sizes available, physical properties, special grades for higher strength, and directions for installation. *Chas. Taylor Sons Co.*

Electrical Precipitation

19—28-page profusely-illustrated booklet describes the Cottrell Method of electrical precipitation for combatting industrial air pollution by removing materials suspended in gases, whether in the form of smoke, mist, fume, fog or dust. Described are manner in which the Cottrell Precipitator works, two basic types of electrical precipitators, general advantages of the Cottrell Process and its application to a variety of industries. *Research Corp.*

Thermit Steel Castings

20—Bulletin outlines materials, equipment and procedures for using Thermi-

(Continued on Page 127)

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CHAPTER ACTIVITIES

(Continued from Page 110)

the art of good casting were the shop practices developed in the core room and the cleaning room and in the inspection of castings.

Mr. Troy concluded his talk by stating that there is need for further development in the pattern shop and in selling of castings. To stay in business, he said, foundries must find ways of competing with forgings and weldments.

Guests of the chapter at the meeting included D. S. Yeomans, chairman of the A.F.S. Metropolitan Chapter; W. G. Kellogg, National Engineering Co., Chicago; Miss C. F. Bryant of G. W. Bryant Core Sand Co.; and W. L. Clark, American Locomotive Co.

Awarded a set of Detroit Chapter bookends as oldest patternmaker present at the Chapter's Old Timers and Apprentices Night was Fred Heiden of Ford Motor Co., 76, with 57 years at the trade. (Photograph courtesy of Walter Ring, Cadillac Motor Div., GMC).

Metropolitan

W. T. Bourke
American Brake Shoe Co.
Chapter Reporter

APRIL 2 MEETING, held at the Essex House, Newark, N. J., was attended by 112 members and guests who heard Earl E. Woodliff, sand consultant, Detroit, speak on *"Sand."*

Mr. Woodliff stated that sand and cores were responsible for a major part of the foundry's scrap. He stressed the need for more sand control and less sand testing. Control actually consists first of selecting materials intelligently and second of using the mate-

(Continued on Page 120)

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FEMA
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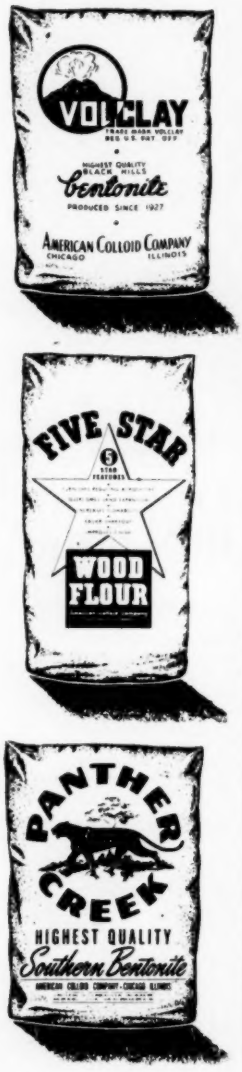
Product Engineering Co., Portland, Ore., has expanded its operation by purchasing all die casting equipment formerly operated by **Pacific Die Casting Co.,** Portland, and has hired all personnel formerly employed in Pacific's die casting operations. Addition of Pacific's equipment to Product Engineering's present die casting plant will enable Product Engineering to handle any type of die casting job from the smallest to the largest, according to Company President R. D. McGilvra.

Rosan, Inc., South Gate, Calif., manufacturers of inserts and studs, announces an extensive increase in its foundry facilities and will conduct experimental work in connection with production of centrifugal aluminum and bronze castings, aluminum and bronze die castings, aluminum sand castings, permanent molds and plastics.

John Mohr & Sons, Chicago engineers and contractors, have been awarded contracts in excess of $14 million for design and construction of two complete blast furnaces, one at Portsmouth, Ohio, and the other at Midland, Pa. The Portsmouth furnace will be built for **Detroit Steel Corp.** and is scheduled for completion in about 12 months. This furnace will have a daily capacity of 1500 ton, making it the largest in the United States. The Midland furnace is for the **Crucible Steel Co. of America,** will have a daily capacity of 900 tons and will start operation in the fall of 1952.



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A new plant, to cost upwards of $10 million, will be constructed for the production of calcium carbide by the **National Carbide Co., division of Air Reduction Co., Inc.,** at Calvert City, Ky. The new plant will occupy part of a 1000-acre tract on the Tennessee river, with the remainder of the acreage held in reserve for expansion and to accommodate other industries engaged in the manufacture of acetylene-based synthetics. Initial rated capacity of the new plant will be 142,500 tons annually, most of which will be shipped out of Calvert City to meet growing demands of metals industries, but as neighboring industrial plants are developed, capacity will be shifted to a "use on the spot" basis. The installation will consume more than 1 million kwh of TVA electricity daily and will have two Norwegian-designed electric furnaces, the first of their kind to be used in this country for production of calcium carbide. Construction of the plant will begin July 1, with the first of the furnaces in operation by January 1, 1953, and the second March 1, 1953.

Great Lakes Carbon Corp., New York, announces the formation of its **Perlite Division.** The new division's Industrial Sales Department, with offices at 18 East 48th St., New York City, will be headed by Harry E. Lewis, who will be responsible for planning and directing all industrial perlite sales for Great Lakes Carbon throughout the United States. Mr. Lewis was formerly manager of the Product Development Department, Building Products Division, Great Lakes Carbon Corp. In his new capacity he will have as a primary objective broadening of industrial markets for new products made from perlite.

Spain's Steel & Iron Institute to Meet

SECOND GENERAL ASSEMBLY of the Spanish Steel & Iron Institute will be held this fall in Madrid. Preceding technical sessions of the Assembly will be extensive plant visitations to important Spanish industrial centers, and social and sightseeing attractions are planned to make foreign visitors welcome. Detailed information on the Assembly program, accommodations and functions are available from Agustin Plana, director, Iron & Steel Institute, Villanueva 15, Madrid.

LETTERS

(Continued from Page 107)

science: systematized knowledge of the conditions and relations of matter; accepted facts and principles as demonstrated by *induction*, *observation*, or *experiment*.

The foundations of science were prepared by Aristotle, who organized a research organization in 331 BC with a grant of $8,000,000 from Alexander, the Great. Aristotle demonstrated what could be done by observation and reasoning (induction). In Aristotle's day, experimental procedure was unknown. The fundamentals of science laid down by Aristotle remained unchallenged for 1500 years. During this period little progress in manufacturing methods was made. It was assumed that all fundamental knowledge concerning the properties of materials was known and classified. Any person rash enough to disprove accepted theories by experimental methods was liable to be burned at the stake as a heretic.

Our modern scientific age began with the founding of the Royal Philosophical Society in 1662. This Society was a government sponsored research laboratory, which followed the teachings of Sir Francis Bacon. In his book *The Advancement of Learning* Bacon stated: "The intellectual world remains shut up within the narrow limits of old discoveries—the art of invention and discovery remains hitherto unknown." Bacon states further: "We must go to nature, instead of to books, tradition, and authority. We must put nature on the rack and compel her to bear witness." This same thought has been expressed by "Boss" Kettering of General Motors Corp., who has stated: "When I want to know if a piston design is any good, I put it in the engine and let the engine tell me." Kettering, Edison, and other modern scientists have repeatedly demonstrated that actual experiments can be far more useful than "fundamental" or theoretical knowledge alone. The proponents of "fundamental" knowledge predicted that airplane flight was impossible.

Modern scientific methods can be classified into seven stages. These are: (1) Define the problem; (2) Define the purpose for working on the problem; (3) Formulate the hypothesis, how the solution of the problem might be obtained; (4) Define methods to be used in experiments; (5) Analyze the experimental results; (6) Draw conclusions from experimental results; (7) Define the new concept.

The keystone of the modern scientific method is (4) the experimental procedure—empirical testing.

An example will be used to illustrate the functioning of the scientific method. The investigator was employed in an automotive foundry. The steps in an investigation were as follows:

1. From 10 to 20 per cent of the cylinder blocks made were defective.
2. The purpose of the investigation was to find a method of reducing the number of defective castings.
3. It was assumed that the hardness of water jacket cores might be related to casting defect.
4. The method of experiment was to

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measure hardness of the cores every hour with a core hardness instrument. Also the pattern was equipped with a date and hour stamp, so that the time of casting could be determined. After 30,000 castings were made, the scrap reports were completed, the data were ready for analysis. This is an empirical test.

Core Hardness of Water Jacket Core	Number of Defective Castings per Hour
60-69	2.75
70-79	3.20
80-89	2.40
90-99	1.68
100	1.20

6. It was concluded that the hard cores were properly baked, and the soft cores were underbaked. Underbaked cores were responsible for part of the scrap castings.

7. Closer control over core-baking conditions was considered necessary.

Since Bacon's time, the analysis of test data has developed into a separate science, mathematical statistics, commonly known as statistical quality control. Also, since Bacon's time, a great many testing instruments have been devised.

Now, let us return to Mr. Wenninger's article. He states that it is wrong to proceed with empirical procedures, and we should, rather proceed upon fundamental principles. As stated before in the Dark Ages, science remained at a standstill because it was assumed that all of the fundamental principles were known. The advance of science since the 16th century has been due to the idea of experimenting and gaining new knowledge from experiments. That is, the introduction of empirical tests and experiments has provided a wealth of information and forms the basis of our modern science and industry. The discovery of the effectiveness of penicillin was due to an empirical test. The discovery of vulcanizing rubber was the result of an empirical test. Thousands of other cases could be cited to illustrate the tremendous value of empirical tests to civilization. Had these investigators waited till they fully understood the disease before they undertook the cure, consider how technical progress would have been slowed up. Had Wilbur and Orville Wright waited until the principles of air borne flight were fully understood, we would not have the airplane today.

The development of a science is speeded up by empirical test procedures. The foundrymen can solve his own problems by trial and error methods faster than by any other method. How then is it possible for electrical and electronic engineers to design such marvelous equipment by using fundamental data only? The answer is that there are 250 years of empirical experiments behind them. The experience of hundreds of investigators has been distilled into scientific laws.

In foundry sand science, our background of experimental data is very small. We know as much about sand now as was known about electricity in the year 1800. We are proceeding in the right direction by using physical tests, high temperature tests, and other empirical tests. The essential information eventually will be extracted. Useful control procedures will survive and useless procedures will be dropped. After many years, the test procedures that survive will be studied, and certain fundamental principles will be inferred.

The control of foundry sand is at present an art. That is, a system of rules and methods are used in order to obtain certain results. Empirical tests are used to control sand. The value of these empirical tests is being determined by the industry. The Caine dip test is another empirical test. These tests have served us well. Considering the advances in foundry sand science that have been made up to date, most of the progress has been due to empirical procedures.

What the foundry industry needs is a textbook on molding sand. This book could summarize the experience of hundreds of foundry men and investigators and would be a great help in developing sand control into a science.

HERBERT H. FAIRFIELD, *Chf. Met.*
William Kennedy & Sons, Ltd.
Owen Sound, Ontario

The response to the publication of this paper has been both amazing and delightful, and I am sure that the paper has accomplished its purpose to get people to thinking about what is really fundamental to foundry sands and sand control. The original title of the paper, "*Some Thoughts on What is Fundamental to Foundry Sand Control*" indicated that the author was thinking out loud in

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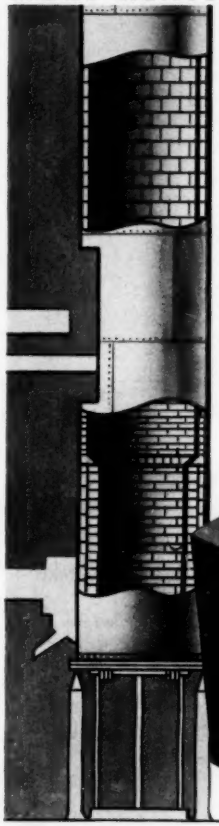

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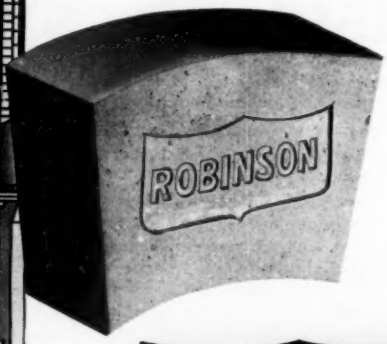

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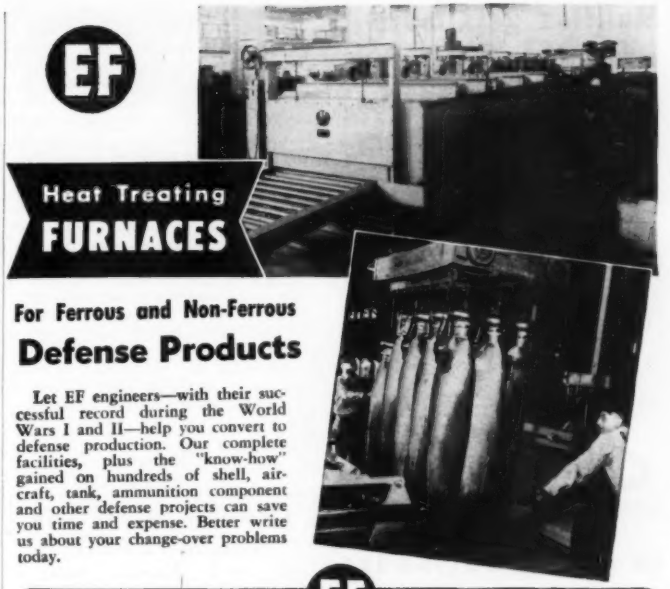
writing. A second mistake was that (in condensing the original talk for publication) we deleted all references to the work that we have been doing here at the University of Kentucky on fundamental sand problems. This left many readers unaware that the talk and the paper originated from difficulties encountered in selling a fundamental research program to a group of practical foundrymen—men who understandably had many mental reservations with regard to the key concept of the program; that the control of the material and mechanical factors of sand processing is but an indirect form of control over the fundamental factors of composition, temperature and time.

From Mr. Fairfield's comments it seems that I failed to make it clear that I hold no brief against empirical experimentation as such, but rather that I strenuously object to much of the thinking that has evolved from far-fetched extrapolations and deductions based upon such experimentation. I am heartily in accord with his general premise that fundamental knowledge has not always led the way but, in actuality, often has been forced to keep up with the surprising results obtained from any number of pure empirical experiments. Yet, in the end, it cannot be gainsaid that most of the great discoveries that have resulted from empirical experimentation have only reached a high state of perfection through their development being furthered by the application of fundamental knowledge—knowledge that perhaps was unavailable at the moment of discovery.

Perhaps more to the point, in the development of any technology (the combining of art with science) there comes a day of reckoning when the technologist must define principles that are equally satisfying in explaining and understanding the practical empirical evidence of the art as well as the more abstract relationships of the science. In effect, the subject paper represents an attempt on my part to warn foundrymen that such a day of reckoning is bound to come and that it might be well to devote some thought to what we are really trying to control in casting metal into sand molds.

Thomas Huxley wrote that science is nothing but trained and organized common sense. Regardless of methods or procedures used in investigation, common sense indicates that all of the different sand practices and variations in all of the different foundries must have some things in common. Fundamentally speaking, there must be a basic set of physical-chemical reactions and effects common in some degree to all processes involving the casting of molten metal against a rammed sand face. Common sense further indicates that only through a better understanding of such effects and reactions can we hope to better understand why certain foundries find it necessary to introduce certain variations to obtain certain results.

I believe the foregoing should make it clear to Col. Krynitsky how the paper became subject to criticism with regard to title and content. As to the Caine dip test, we have found it to be quite informa-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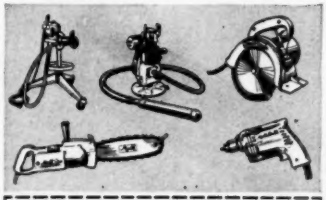

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tive upon the fundamental behaviour of a great number of sands tested under a wide variety of simulated mold pouring conditions. Apparently, and unknowingly, we have arrived at conclusions quite compatible with those obtained by Moore and the Ross-Meehan technicians using their new type dilatometer. However, because of the terms under which our work has been performed we cannot present details for general publication. It can be stated that information from dip tests has been successfully used time and again to predict the actual behaviour of a specific sand when applied to a standard test casting.

I have quite enjoyed having my thoughts praised by one set of eminent authorities and hotly condemned by another set of equally eminent authorities. Perhaps this situation can also be accepted as being indicative of the present status of foundry sand control in the foundry industry.

CLIFFORD E. WENNINGER, *Dir. Fdry. Res.*
University of Kentucky
Lexington, Ky.

CHAPTER ACTIVITIES

(Continued from Page 115)

rials properly. Materials should be ordered according to definite specifications and simple tests made to determine whether the specifications are being met, he said.

The speaker described the characteristics and functions of the various kinds of binders, stating that most binders retain their own individual characteristics when mixed with sand; thus if the properties of the binder itself are known, its effect on a molding or core sand can be predicted. He recommended keeping the clay content of molding sands between 9 and 14 per cent stating that higher percentages tend to develop clay balls while lower percentages result in higher expansion causing scabs and buckles.

Mr. Woodliff advocated a wide-spread grain distribution and recommended blending two or more sands in order to achieve a 4 to 6 screen spread in preference to a 2 to 3 screen spread. He emphasized density as an important factor in reducing scabs, buckles and metal penetration, and suggested weighing the standard permeability test specimen as a simple test for density. Weights of less than 160 grams (corresponding to 95 lb per cu ft), he said, are prone to metal penetration, and weights up to 200 grams (120 lb per cu ft) have been used successfully in steel. Density can be increased by spreading the grain distribution, using higher percentages of gravel, using bentonite in combination with fire clay, using silica flour or iron oxide, or when necessary using a heavy material like zirconite or chromite.

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BOOK REVIEWS

Non-Destructive Testing

Symposium on the Role of Non-Destructive Testing in the Economics of Production. 164 pp. Illustrated. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3. $2.50. (1951).

Six extensive papers and discussions of non-destructive testing in industry are frankly aimed at capturing the attention of management and present unbiased views on the potential values of non-destructive testing in increasing product quality and cutting production costs.

Sponsored by ASTM Committee E-7 on Non-Destructive Testing, the Symposium includes papers on "A Basic Guide for Management's Choice of Non-Destructive Tests," "Discontinuities in Cast and Wrought Products That can be Revealed by Non-Destructive Tests," "The Role of Non-Destructive Testing in the Economics of Casting," "The Economics and Practical Application of Cobalt 60 in the Radiographic Inspection of Steel Weldments," "The Economics of Wrought Steel Inspection," and "Management's Responsibility for Insistence on Non-Destructive Testing in the Development of New Engineering Products and Processes."

Metal Directory

Standard Metal Directory, 818 pp., published by Atlas Publishing Co., Inc., 425 West 25 St., New York, N. Y. $15 (1950).

Twelfth edition of this Directory is divided into five sections: (1) iron and steel plants, (2) ferrous and non-ferrous foundries, (3) metal rolling mills; (4) metal rolling plants, and (5) smelters of non-ferrous metals. Directory contains 10,000 detailed reports on foundries and other metal plants, listing them geographically and alphabetically and giving the name of the company, plant equipment, capitalization, products, primary and secondary materials consumed and names of the company's officers, purchasing agent and sales manager. In addition, the Directory lists U. S. distributors of pig iron, ores ferro-alloys and coke ovens, die-casting plants, metal powder producers and sellers, smelters and refiners of non-ferrous metals, storage battery manufacturers, scrap iron and scrap metal manufacturers, dealers in pipe and rails, railway purchasing agents, etc.

Apprentice Training

Teaching Apprentices and Preparing Training Materials, by Miles H. Anderson. 170 pp. Illustrated. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago 37. $3. (1950).

This volume provides the technology of teaching as it applies to apprentices and is designed both as a source of techniques for the beginning teacher and as a refresher course for experienced teachers of apprentices.

Covered in this volume are background and development of apprenticeship training; operation of an apprenticeship program; apprenticeship training in trade

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and industrial education; the craftsman and apprentice teaching; problems in apprentice teaching; starting a new apprentice class; teaching an apprentice class; tests and rating scales; visual aids, analysis of technical content and course construction; preparation of instruction sheets; and on-the-job apprentice teaching.

Welding and Cutting Safety

Safety in Electric and Gas Welding and Cutting Operations. 42 pp. Published by American Welding Society, 33 West 39th St., New York 18, N. Y. $0.50. (1950).

Prepared by a committee sponsored by the American Welding Society under the procedures of the American Standard Association, this booklet (American Standard Z49.1-1950) reflects best recommendations of welding engineers, safety engineers, equipment manufacturers and insurance, governmental and labor organizations.

American Standard Z49.1 covers regulations for the safe installation and operation of welding equipment for all arc, gas and resistance welding processes. Provisions are included for fire prevention and protection in regularly assigned welding locations and other areas. Protection of personnel is covered from the standpoint of the welder and of other workers in areas adjacent to welding operations.

Also included are precautions for welding of materials giving off toxic fumes in confined spaces.

Ultrasonic Testing

Symposium on Ultrasonic Testing. 140 pp. Illustrated. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3. $2. (1951).

Ten papers and discussions included in this volume represent a summary of the history, theoretical aspects, basic principles of practical testing and practical applications for the ultrasonic testing of materials as presented at sessions sponsored by ASTM Committee E-7 on Non-Destructive Testing at the ASTM Annual Meeting.

Several of the papers include an appropriate list of references, and one bibliography constitutes 342 references to the inspection, processing and manufacturing control of metals by ultrasonic methods.

Arc Welding

Modern Arc Welding Lessons—AC & DC. 192 pp. Published by Hobart Trade School, Inc., Troy, Ohio. $1.

This volume comprises Part II of the new Hobart handbook, *"Electric Arc Welding—Procedure and Practice,"* and contains the complete series of 40 arc-welding lessons offered by the Hobart Trade School.

Text material is divided into welding lessons of gradually-increasing difficulty and includes preliminary instructions, starting and manipulating the arc, welding common joints with bare electrodes, welding light gage sheets with coated electrodes; general welding with coating electrodes in the flat, horizontal and overhead positions; pipe welding, welding cast iron and special practices and tests.

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PERSONALITIES

(Continued from Page 97)

Corp., New York, has been named assistant to Company President Howard C. Moncrieff. Mr. Zino is a past vice-president of the American Society of Lubrication Engineers.

Harry G. Andersen, district sales engineer at the Milwaukee office of Link-Belt Co., has been appointed district manager at Birmingham, Ala. Mr. Andersen started with Link-Belt in 1937 at the company's Pershing Road Plant, Chicago, where he served in various engineering capacities before transfer to Milwaukee in 1948.

Erik O. Lissell, former director of the foundry division of the Swedish Federation of Mechanical Engineering Industries, Stockholm, Sweden, and editor of *Gjuteriet,* Swedish foundry magazine, is now foundry manager Björneborgs

Erik O. Lissell

Jernverks AB, Björneborg, Sweden. The foundry produces gray iron castings for compressor and combustion engines, heat and corrosion resistant high alloy cast iron, steel, non-ferrous castings, and steel mill rolls.

E. C. Corson, Jr., who has been assistant credit manager at the Whiting, Ind., and Detroit offices of Federated Metals Division, American Smelting & Refining Co., has been appointed credit manager of the Division's San Francisco territory, which includes Portland, Seattle and Salt Lake City. Mr. Corson has been with Federated for 16 years.

Ross J. Martin, associate professor of mechanical engineering, has been appointed associate director of the University of Illinois Engineering Experiment Station, Urbana, Ill., where he will serve as liaison between the Station and agencies sponsoring its investigations.

James F. Squarey has been named material control supervisor for Hunt-Spiller Mfg. Corp., Boston.

Charles F. Scott has rejoined Hunt-Spiller Mfg. Corp., Boston, as supervisor of foundry production scheduling. Recently for five months he was with Boston

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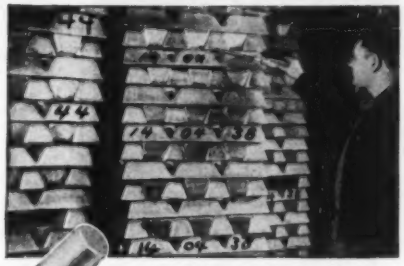

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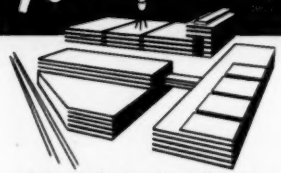

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Electro Steel Castings, Inc. Mr. Scott came to Hunt-Spiller from the Chelmsford Iron Works, Lowell, Mass., in August, 1926 and has been engaged in production control work since 1936.

Robert G. Faverty, managing director of Armstrong-Whitworth & Co., Pneumatic Tools, Ltd., Newcastle-on-Tyne, England, was recently elected a vice-president of Independent Pneumatic Tool Co., Aurora, Ill. Mr. Faverty was formerly manager of Independent Pneumatic Tool Co.'s Chicago and Detroit branches. Re-elected were Executive Vice-President **W. A. Nugent,** Secretary **John A. McGuire** and Treasurer **James A. Lind.**

OBITUARIES

Joseph F. Burle, 70, co-founder of Lakeside Bronze, Inc., Buffalo, died recently at Deaconess Hospital in that city. Mr. Buhrle was foundry superintendent for the Buffalo Bronze Corp., for 15 years prior to forming Lakeside Bronze, of which he had been vice-president and treasurer for 19 years at the time of his death.

George G. Adams, sales engineer for the Machine Division of Osborn Manufacturing Co., Cleveland, in its New England territory for 17 years, died March 31 at his home in Ridgewood, N. J. Mr. Adams had been associated with Osborn for 30 years.

James W. Moore, 61, a director and head of the Special Products Division of American Cast Iron Pipe Co., Birmingham, Ala., died March 3 at his home in that city. An employee of American Cast Iron Pipe Co. for 34 years, he served the company in several executive capacities, including those of chief engineer and works manager, prior to heading the Special Products Division. Mr. Moore was a native of Hickory, N. C., and a graduate of Alabama Polytechnic Institute, and was author of the book *The Better Business of Living.*

Clifford W. Morisette, 41, assistant professor of industrial engineering, Pennsylvania State College, died March 21 at State College, Pa. Professor Morisette had been an active member of the A.F.S. Educational Division for several years and at the time of his death was serving on its Program & Papers Committee and as vice-chairman of the A.F.S. Apprentice Contest Committee. Holder of a B.S. and an M.S. in industrial engineering from Stout Institute, he served his apprenticeship in the foundry industry at Allis-Chalmers Mfg. Co., Milwaukee, and for several years was foundry instructor at the Milwaukee Vocational School prior to joining the Pennsylvania State College faculty in 1946. Professor Morisette had been a member of A.F.S. since 1935.

Frank Chambers, deputy smoke inspector for the City of Chicago, died March 21 in that city. Mr. Chambers had been closely associated with the foundry industry through his work on the Chicago Cleaner Air Committee in helping the industry combat air pollution problems.

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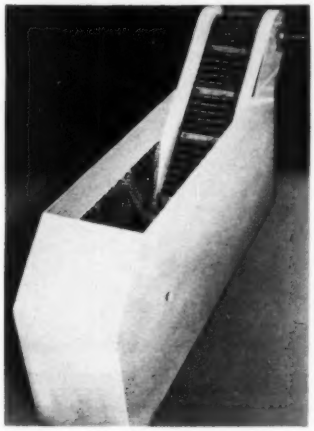
NEW PRODUCTS

(Continued from Page 113)

intensity. Connections can be made to a wide variety of existing alarm and automatic extinguishing systems. *Fireye Corporation.*

Quenching-Conveying Unit

21—Designed for continuous heat-treating of individual pieces, quenching and conveying unit has tank in which oil is recirculated and cooled. Metal belt allows quenched parts to drain as they



move up inclined conveyor which is driven by self-contained power unit. Overall dimensions are: length, 8 ft; width, 2 ft; height, 4 ft. Cleats or flights can be attached and larger conveyors can be built to accommodate heavier and larger parts. *Klaas Machine & Mfg. Co.*

Fork-Shovel Attachment

22—Hydraulically controlled heavy duty fork-shovel attachment for lift trucks is designed to handle such loose materials as castings, coal, coke, broken stone, etc.

Heavy 7-¾ in. tapered tines ease their way into and under materials with minimum tractive effort and least possible shock to the truck. Shovel can be tilted up to 40 degrees above horizontal, including 10 degrees tilt of upright assembly, permitting it to scoop maximum loads without ramming stock pile. Generous

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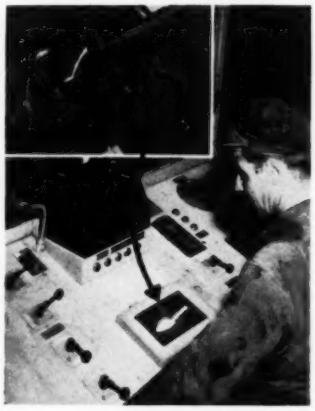
Televising Pouring Operations

23—Now in use in the steel industry but equally applicable to the foundry industry is the Utiliscope Camera, a wired television device that enables an operator some distance away to monitor pouring



operations. As illustrated here in an operation involving continuous casting of steel billets, an operator 50 feet away and out of heat and danger watches pouring operation.

Metal Separator

24—Dry Process Metal Separator, for use on all non-ferrous metals, extracts useable metal from skimmings, slags, dross and sweepings. Process operates automatically, requires no skilled operator, is easily maintained and needs no heat or water. Separator recovers waste metal at once, making it available for immediate resmelting; eliminates accumulations of skimming over a period of time; and produces from 50 to 80 per cent metal recovery, manufacturer claims. Separator is available in two sizes: No. 1 for small and medium plants; No. 2, with three times the capacity of No. 1, for large plants. *Peerless Metal Separator Co.*

Permanent Plate Magnets

25—Non-electric Alnico Perma-Plate magnets are now available in three magnetic field ranges and are designed for removing miscellaneous tramp iron from wet or dry materials in process, in order to protect machinery, prevent sparks or purify non-magnetic substances. Each of these types is made in 19 standard sizes from 4 to 72 in. wide and in 2, 4, 6 and 8 pole styles. Magnets can be installed above belt and slat conveyors, in open or closed wood or metal chutes, in ducts, spouts and troughs, above and below feed tables or integrally in various types of processing machinery. *Dings Magnetic Separator Co.*

LITERATURE

(Continued from Page 114)

cast, a mixture that enables the foundryman to produce sound clean steel castings of intricate shapes, irrespective of size, without resorting to regular steel melting facilities and requiring neither fuel nor a source of electrical power. Steps in this process of producing steel chemically are described in detail, typical castings made from Thermicast are shown, and a chemical analysis and physical properties of Thermicast steel are given in the booklet. *Metal & Thermit Corporation.*

Fork Trucks

26—Comprehensive 44-page catalog gives general description and application data on the Yale line of electric fork lift trucks, motorized hand trucks, hand lift trucks and hand and electric hoists. Special section describes various industrial truck attachments. *Yale & Towne Mfg. Co., Philadelphia Division.*

Industrial Vacuum Cleaning

27—16-page illustrated Catalog A-816 describes industrial dust hazards and explains how Hoffman heavy duty vacuum cleaning equipment provides rapid, thorough and economical removal of these hazards. Shown pictorially and with text are typical vacuum cleaning applications and installations, principal elements of the Hoffman cleaning system, primary and secondary dust separators, typical piping layout, right and wrong ways of connecting pipes, and Hoffco-Vac portable industrial vacuum cleaners. *United States Hoffman Machinery Corp.*

Impregnating Process

28—Eight-page bulletin explains in detail equipment used in the Mogul Cast-Seal Impregnating Process, claimed by its manufacturer to be a positive, low-cost method of eliminating porosity in castings. Described are two impregnating methods: (1) vacuum pressure machine for batch impregnating, and (2) pressure machine for testing and impregnating. Specifications and applications are given for the M-30 Mogullizer, Mogul Circulators M-500, M-1000 and M-2500. Also mentioned are the M-750 booster pump and Mogul Cast Seal Colloidal. *Metallizing Co. of America.*

Blast Cleaning Hose Machines

29—Illustrated Catalog No. 100 shows complete line of Pangborn hose-blast cleaning machines for foundry use. Specifications, advantages and applications are given for Type AB blast machines, Type AV hose blast machines, Type AY suction feed blast machines, No. 2 AB-2-Blast machines, AC-3 Blast Machines, AU-11 blast machines and the AQ-1 direct-pressure continuous abrasive blast. Each of these models is described in detail in a separate enclosed folder. *Pangborn Corporation.*

Interchangeable Cartridge Respirator

30—Bulletin S142, 4 pages, describes the new AO R2000 respirator, which features "twist of the wrist" interchangeability of all cartridges, filters and accessories, and protects wearer against toxic and non-toxic dusts, acid gases and vapors. New retainer shell accommodates seven types of replaceable filters, thus offering protection against both dust and chemical gas and vapor hazards by interchanging cartridges. Bulletin also contains for quick reference a respirator chart which tells at a glance which respirator and filter to use with each type of industrial dust or gas hazard. *American Optical Co.*

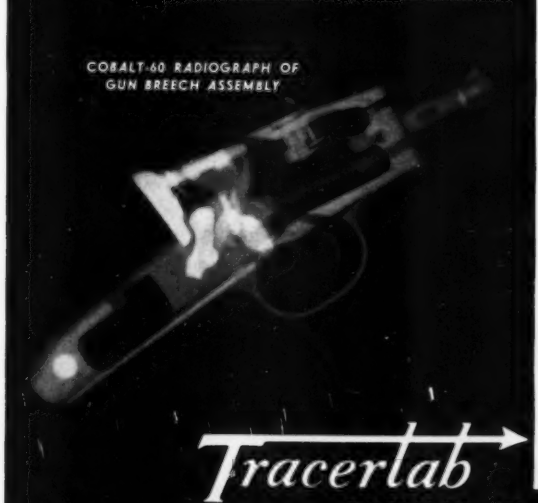
Plastic Refractory

31—Bulletin 100, four pages, describes Nojoint, a modern plastic refractory, and its use for rammed-in walls and baffles of boiler furnaces and in hand-fired, stoker-fired and oil-fired boiler furnaces. Used in heat-treating furnaces, Nojoint eliminates joint failures, spalling in the arches, and flame erosion of sidewalls. Sodium cyanide furnaces, forge furnaces and car-type annealing furnaces are among types pictured in the bulletin. *Ironton Fire Brick Co.*

Electropolisher

32—Bulletin provides information on the theory and practice of electrolytic polishing of metallurgical samples, together with description of the Buehler-Waisman Electro Polisher. *Buehler, Ltd.*

COBALT-60 RADIOGRAPHY SOURCES



Cobalt-60 is now available at low cost in the form of high specific activity sealed sources especially designed for use in industrial radiography. Cobalt-60 radiographs are indistinguishable from those made with radium.

Sources are sealed in small ferromagnetic stainless steel capsules designed for handling with a magnet, a string, or by a handle screwed into the end of the capsule. Specially designed lead storage containers are also available. Two hundred and four hundred millicurie sources are available from stock. Other strengths can be made on special order.

Write for Bulletin AF-31

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Midwest Office
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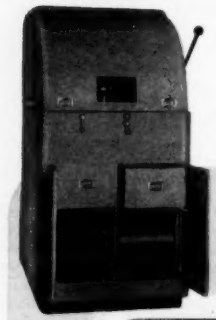
TRACERLAB INC., 130 HIGH STREET, BOSTON 10, MASS.

Buehler

ABRASIVE CUT-OFF MACHINE

for the Metallurgical Laboratory

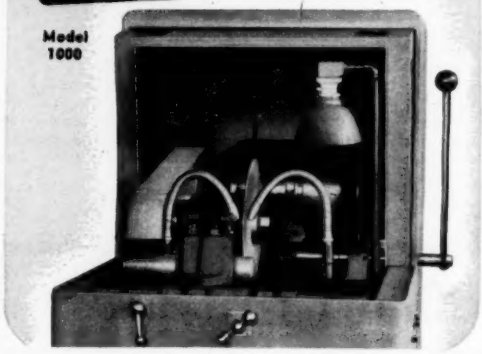


Completely enclosed—full protection for the operator

Fast cutting

Smooth operating

Model 1000



The Buehler Cut-off Machine No. 1000 is a solidly built heavy duty machine free from vibration and side play with capacity for cutting specimen sections up to 3½".

Cutting is done on the front of the wheel and is controlled by a convenient outside lever. With the cover closed, the cutting operation can be viewed through a heavy wired glass window. Regular equipment includes 3 HP totally enclosed ball bearing motor 1750 r.p.m., 220 v., 60 cycle, AC, 3 phase; pump motor ¼ HP, 220 v., 60 cycle, 1 phase; six cut-off wheels 12" x 3/32" x 1¼". Wheels not in use are stored in a spacious compartment in the base, which also contains a removable sludge collection chamber. The self-contained cooling system provides a flood of water for cool cutting. Overall dimensions 31" x 47" x 64" Shipping weight, 1400 pounds.

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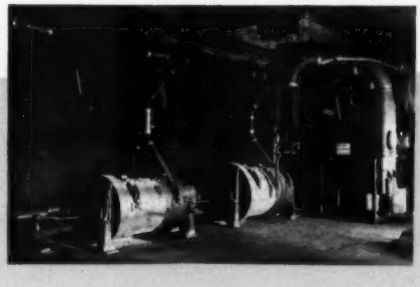

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